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REPORT

OF

MANITOBA ELECTRIFICATION ENQUIRY COMMISSION

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THE HON. JOHN BRACKEN, *Premier*
Government of Manitoba
Winnipeg, Manitoba

DEAR SIR:

We have the honour to submit herein our report on the problem of farm electrification for the postwar period.

Respectfully submitted,

E. V. CATON
JOHN W. SANGER
HERBERT COTTINGHAM
EMERSON P. SCHMIDT, *Chairman*

TERMS OF REFERENCE OF THE MANITOBA ELECTRIFICATION ENQUIRY COMMISSION AND THE COMMISSION'S PROCEDURE

In creating the Manitoba Electrification Enquiry Commission, Premier John Bracken addressed a letter on June 11, 1942, appointing the chairman as follows:

Dr. Emerson P. Schmidt
University of Minnesota
Minneapolis

Dear Dr. Schmidt:

In order to meet and if possible avoid, after the present war, the depression, unemployment and distress such as followed the last Great War, the Government of Manitoba is planning now, policies aimed to provide employment and at the same time, if possible, a betterment of living and working conditions among our people. Obviously unemployment can only be prevented by the provision of employment; and our object is to provide such employment upon projects which will not only repay the money spent upon them but will as well supply much needed public services.

The rural hydro electric system of Manitoba has been in existence for more than twenty years, and has been actively extended during the last ten years. There are, however, still only some five hundred farmers, out of a total of some fifty-nine thousand, who have found it possible to use this service. It is clear, therefore, that much still remains to be done to extend to the farms of Manitoba a service which will not only make them more productive by providing facilities for the diversification of agriculture, but will lessen the physical drudgery now borne by farm women and make farm life more attractive to young people.

Therefore, as a part of the Government's larger programme of planning for postwar development to avoid unemployment and depression, the Government is anxious to gather together the data upon the basis of which it can formulate a practicable policy for the expansion of the Manitoba hydro electric system to serve as large a proportion of Manitoba farmers as possible.

At the present time, because of the much lower density of population in the rural districts as compared with the urban districts and because of the fact that the great majority of farmers are located at a considerably greater distance from the centres of power production than the citizens of Greater Winnipeg, the cost of electricity to rural residents is substantially higher than it is in the City of Winnipeg. If the hydro electric system is to be expanded to the extent that in the interests of our whole society it should be, this gap between the cost of electricity to urban dwellers and the cost to the rural residents of the Province of Manitoba must be narrowed.

With the above situation in mind the Government has decided to set up a Commission and it is our desire that you act as Chairman. The purpose of this Commission will be to investigate the present system of generating, transmitting and distributing electricity in Manitoba in order to ascertain whether economies cannot be effected by its reorganisation which will enable the Manitoba Government to make available to Manitoba farmers a supply of electrical energy at a substantial reduction in its present cost without at the same time increasing the standard rates for such electricity to any citizen of Manitoba.

We are asking Mr. E. V. Caton, Mr. J. W. Sanger and Mr. Herbert Cottingham of this city to be the other members of the Commission.

Owing to your recognized competence in this field, you will confer a great favour upon the Government if you will accept the Government's invitation to act as Chairman of this Commission.

Yours very truly,
JOHN BRACKEN

The Commission began its work in the middle of June, 1942. After planning the broad scope of the enquiry, the Commission made a study of the progress of farm electrification in Manitoba to date. In this connection

an attempt was made to take a census of the farmers now receiving electric power, ascertaining the date when they first took the service, the cost of this service to them, their utilization of energy, and other matters.

In order to determine the feasibility of a farm electrification programme, the Commission, through the co-operation of the Department of Agriculture of the province, selected seven representative townships in an equal number of areas in the province for a survey of the pattern of agriculture, the type of buildings, distance between farmers, annual income, and other relevant material in order to secure an estimate of the cost of bringing electric power to the farmer in the several parts of the province.

Because of the progress in farm electrification made in the United States and Ontario, the Commission made special investigations of the problems, procedures, and achievements in these two areas.

The Commission through the press and the *Manitoba Gazette*, as well as orally, informed the public that it was prepared to receive submissions from any interested party or organization.

In addition to the above, the vast literature on farm electrification which has grown out of the experience of Western European countries, the United States, and Canada was carefully examined.

A special questionnaire was prepared and sent to all co-operatives distributing electricity to the farmers of North Dakota and Minnesota, as well as to selected co-operatives of other states.

Out of this mass of opinion, fact, and data, the Commission was able to arrive at a positive conclusion with regard to the feasibility of farm electrification and to plan a programme for action in the immediate postwar period which the Commission believes is adapted to Manitoba conditions.

ACKNOWLEDGEMENTS

Without the wholehearted co-operation of many persons and organizations the Commission would have been forced to be satisfied with a much less comprehensive document. Mr. Jack Chernick served as research assistant from June until the middle of September in charge of the field survey and compilation of data to determine farm density and the probable demand for power.

Mr. Harry Slattery, Director of the Rural Electrification Administration, and many of his assistants, especially Mr. A. A. Walters, Mr. M. M. Samuels, and Mr. C. O. Faulkenwald, as well as numerous other persons of the R.E.A., gave unstintingly of their time, information, and experience; their contribution was of great value to the Commission. Likewise, Dr. Thomas H. Hogg, Chairman of the Ontario Hydro Electric Power Commission, and Mr. R. T. Jeffery and Mr. J. J. Jeffery, engineers of that Commission, are among those to whom we are indebted. Thanks are also due to many employees of the local R.E.A. co-operatives in the United States.

Hon. S. S. Garson, Major Henry C. Grant, Mr. Ralph McN. Pearson, Mr. C. H. Attwood, and Mr. Donald G. McKenzie gave of their time and experience.

Throughout the investigation and study the employees of the Manitoba Power Commission were always ready and able to furnish information at critical points. The co-operation of Mr. William D. Fallis, Mr. G. A. Wrighton, Mr. Leslie Mackay, Mr. J. R. Sarsfield, Mr. F. B. Brisbin, and Mr. J. W. Tomlison was especially appreciated. The provincial departments of agriculture and of municipal affairs also provided valuable information.

Dr. H. H. Speechly attended most of the sessions of the Commission, participated in the discussions, and was always ready to impart viewpoints and information drawn from his experiences in the rural life of Manitoba.

In addition to the above, many other persons were interviewed and their contributions gratefully received. A vast literature in agricultural economics and in rural electrification was examined; this Commission wishes to acknowledge the silent but indispensable role which the printed record played in the development of the programme of farm electrification herein contained.

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FINDINGS AND RECOMMENDATIONS

Findings

1 Electricity on the farm has profound and far-reaching effects upon the social as well as economic aspects of farming. It reduces drudgery upon the farm as it has done in the factory; it increases income, reduces costs of production and by removing the disparity between the urban and the rural way of life brings a large measure of contentment to people upon the farm. (Chapter IV.)

2. In few major areas in the world is town and farm interdependence as pronounced as is the case in Winnipeg and rural Manitoba. (Chapter III.)

3. To bring electric power in the postwar period to the majority of the 58,686 farmers in the Province of Manitoba is entirely feasible and practical. (Chapter IX.)

4. Manitoba agriculture, because of certain climatic and market difficulties, requires constant adaptation to a changing world—an adaptation which may be substantially facilitated by the use of electric power on the farms. (Chapters II and III.)

5 Farm electrification in a large part of the Western world is an accomplished fact, or is in process of becoming so. In the United States, for example, two out of every five farmers are supplied with electric power and Manitoba's farmers should not be forced to lag behind this movement, if Manitoba's economy is to retain its place in the world economy. (Chapter V.)

6. A man working with his own muscle-power alone never can do, in a day, the equivalent of work done by one kilowatt hour of electricity, which unit of energy rarely costs more than 5 or 10 cents. No other form of power for the farm can compare with the low cost, convenience and adaptability of central station electric service. (Chapter IV.)

7 The electrification of farm areas merits a high priority as a postwar employment programme because it will be more nearly self-supporting than most other projects which might be considered, although it is recognized that self-liquidation should not be the only test in the selection of postwar employment projects. (Chapters V and IX.)

8. In order that farm lines may be built economically it is necessary that construction work be scheduled at a uniform rate. A construction programme of 25,000 farm services in the first ten years is considered to be a minimum initial objective. (Chapters IX and X.)

9. The capital cost of 25,000 farm services based on 1939 prices and the attainment of 80% saturation of possible farm services, is estimated to be $16,831,687.50. At the end of ten years and after deducting sinking fund, the net debt for 25,000 farm services will amount to $14,426,860.52 (Chapter IX.)

10. On the same basis, the capital cost per farm service is estimated to be $673.27. On the basis of 1942 prices the estimated cost is approximately 8% higher. (Chapters V and IX.)

11. The ultimate capital cost of complete farm electrification beyond the tenth year is difficult to forecast. If the average prices are those prevailing in 1939, an additional capital expenditure of $10,000,000 may be required. (Chapter IX.)

12. To supply farm services at a rate similar to the standard rate schedule now in effect in the towns and villages, namely, 8 cents for the first 50 kwhr per month and 2 cents for all additional energy, (but minimum net bill $3.60) will require a bonus *rate* equal to that now paid to the Manitoba Power Commission. Owing to the relatively high capital cost of farm electrification the bonus will equal $21 per farm service per annum. (Chapter IX.)

13. Under the terms of the existing water power leases there will not be sufficient water power rentals to pay the combined bonus requirements of farm electrification and the M.P.C. network. (Chapter IX.)

14. Under the present system of bonus, the amount required for service to 25,000 farms in ten years will be $21,000 in the first year, increasing progressively to $526,000 in the tenth year. To provide sufficient revenue from farm electrification to meet the additional cost resulting from a bonus not being paid, the service rate would require to be increased to 10 cents for the first 50 kwhr per month, 4 cents for the next 50 kwhr per month and 2 cents for all additional energy with a minimum net bill of $4.50 per month. (Chapter IX.)

15. There is adequate power, available from the Winnipeg River, to provide for a complete farm electrification system for Manitoba. It is estimated that the average peak demand per farm would be 600 watts and that the peak demand for 25,000 farms would not exceed 30,000 h.p. at the power plants. This constitutes only 5% of the total power available from the Winnipeg River. (Chapter XI.)

16. It is indisputable that the high cost of electric appliances is the greatest handicap to the complete utilization of electricity on the farm. Farm service for lighting only is not practical under the conditions existing in Manitoba. (Chapters IX and X.)

17. Even though the farmer may be required to pay a minimum monthly bill of $3.60, this monthly expense to the farmer for electric power is not entirely an additional expense because over half of it replaces other existing or present costs such as coal-oil, radio battery charging, etc. (Chapter IX, Appendix A, Table 24.)

18. If the minimum monthly bill is $3.60, the Manitoba Power Commission may assume that within a few years at least half of the farmers will find electric power so beneficial that they will use energy in excess of the minimum and thus ensure the entire system adequate revenue. (Chapter IX, Appendix B, Tables 6, 7 and 8.)

19. Unless capital funds are secured at an interest cost not to exceed 3.5% it will not be possible to carry out any comprehensive farm electrification programme. It may be noted that the farmers in the United States are securing funds under the rural electrification administration for 2.46% and are anticipating a further reduction. (Chapters IX and X.)

20. That central governments through fiscal or treasury and central bank policy have it within their power largely to determine interest rates is now widely accepted by students of the problem, and therefore uneconomical high interest rates are no longer necessary. (Chapter V.)

21. Since postwar reconstruction and with it the problem of unemployment have come to be accepted as national responsibilities,[1] the Government of Manitoba may anticipate the co-operation of the Dominion Government in the raising of necessary funds at low interest rates for the farm electrification programme. (Chapter V.)

[1] "The experience of the past decade is conclusive evidence that unemployment relief should be a Dominion function." Report of the Commission on Dominion-Provincial Relations (Rowell-Sirois), Book II, Recommendations, p. 24.

Recommendations

1. In so far as this will not interfere with the war effort, the Manitoba Power Commission and the Government of Manitoba should inaugurate preliminary surveys, set up detailed plans and make all other preparations required to enable the farm electrification programme to go into action promptly when the war is over. (Chapter V)

2. Because of the social and economic significance of farm electrification for the Manitoba economy, the scope of the programme should not depend exclusively upon the volume of unemployment prevailing in the postwar period. (Chapters IV and V.)

3. The Manitoba Power Commission has planned to bring power to every town, village, and hamlet of more than 20 persons and which communities are either not served at all, or inadequately served, this part of the postwar programme should be completed in not more than five years, because the network of electrical circuits so developed will become basic for the distribution of energy to the farm lines throughout the Province. (Chapter IX)

4. Meantime, farm electrification should commence at once after the war with a minimum of 1,000 farmers to be connected the first year, and a steadily increasing number in subsequent years, depending upon the experience gained and the state of unemployment prevailing. (Chapter IX.)

5. Since farm electrification can be established only under conditions of maximum economy, farm lines should become an integral part of the Manitoba Power Commission and it is recommended that all terms and conditions of the Manitoba Power Commission Act be made to apply to farm electrification. (Chapter IX.)

6. Line construction should commence first where the largest number of farmers can be supplied with a minimum amount of investment cost, estimated revenues considered. (Chapters IX and X.)

7. Under the terms of the Manitoba Power Commission Act complete authority is given to provide customers with all necessary wiring, appliances and apparatus at the lowest possible cost. It is recommended that this policy be continued for farm electrification. (Chapters IX and X.)

8 Since the success of farm electrification is dependent upon securing adequate revenue, and since such revenue is a function of use, every effort should be made to supply the farmers with appliances at minimum cost.

In view of the disparity between Canadian and United States prices for electrical apparatus and appliances, it is recommended that the Government of Manitoba use its influence at Ottawa to have the duties so adjusted that prices in Canada shall be nearer to those in the United States.

This is in line with the declared policy of Article IV of the Atlantic Charter and Article VII of the Lend-Lease Agreement signed February 23, 1942, and the exchange of notes between Canada and the United States in December, 1942, the free flow of international trade being the prime objective

The Commission is of the opinion that such adjustment of the tariffs would also be of benefit to the Canadian manufacturers, since they would then have the benefit of the mass market, and that instead of decreasing employment in manufacturing it would have the opposite effect. (Chapter X.)

9 Farm lines should not be built in any area unless there is adequate assurance that there will be sufficient return on the capital investment. (Chapter IX.)

10 A rate schedule should be adopted which gives the farmer every inducement to use the maximum amount of energy and should conform as closely as possible with the uniform standard rates for towns and villages. (Chapter IX.)

11 Farmers in local areas should be organized into local advisory and promotional bodies in order to facilitate the signing up of as nearly 100% of the farmers in the community as possible, engage in load building and educational work on the uses of electricity, safety measures, and patrol activities. (Chapter X.)

12. The farmers should be required to read their own meters, bill themselves and in this and all other ways possible help to reduce the operating costs of the system. (Chapters IX and X.)

13. In the less densely settled areas, and where it is practical and essential, the farmers themselves should be organized into self-help bodies under which they would receive credit or cash for procuring materials and doing

other work in order to reduce the cost of the lines and to enable the farmers to build up a fund for the purchase of wiring materials and appliances. (Chapter X)

14. Farm lines should be built wherever possible on private rights-of-way so as to avoid future costs which might be involved in road widening and such rights-of-way should be made available to the Manitoba Power Commission by the farmers free of cost. (Chapter X)

15 The Commission has investigated the feasibility of a plan for the more economical operation of the present system of generating, transmitting, and distributing electricity in Manitoba. Substantial savings can only be made by eliminating as far as possible the duplication of property and operating staffs of the three major electric utilities, the Winnipeg Electric Company, the City of Winnipeg Hydro Electric System and the Manitoba Power Commission.

There is no doubt that large savings can ultimately be made particularly in the capital investment in, and fixed charges on properties, but these cannot be accurately determined until the final plan of reorganization is fixed upon.

The Commission was not empowered to conduct negotiations in an effort to bring the said utilities together in order to work out a plan of reorganization and is of the opinion that in any event the present time is not opportune for such negotiations.

If it is desired that a complete investigation be made of this matter, we recommend that it be carried out by a body whose membership is not identified with the management of any of the utilities concerned.

CHAPTER II

MANITOBA'S ECONOMY

Introduction

The people of Manitoba are heavily dependent upon agriculture. Improvement in the well-being of farmers is likely to be beneficial to all the people of the province. Agriculture has not been prosperous since the beginning of the 1930's. For these reasons persons in responsible positions of leadership must make every effort to supply farmers with equipment which will reduce costs, increase returns from farming, and make farming a more attractive way of life.

Electric power on the farm, while no cure-all for the basic disabilities of western Canadian agriculture, may make a substantial contribution to its improvement. Furthermore, the manufacture of electrical apparatus and the construction of power distribution facilities can reduce the volume of unemployment in the postwar period and are, therefore, activities well fitted to act as a depression buffer. In the United States 38% of the farms are supplied with electric power, in contrast, less than 2% of Manitoba farms enjoy electric service.

Electric power makes farming more profitable. In many areas electricity encourages greater diversity of farm products, helps improve their quality, and increases the physical output per labour-hour spent on the farm. Electric light makes the farmhouse brighter and more pleasant. Electric power removes much of the drudgery of washing, milking, and water-pumping. Electric power can make a substantial contribution toward the better economic and social balance between rural and urban life which many regard as essential for national well-being.

These assertions will be amply demonstrated in subsequent pages. There is, however, one statement whose proof will require no great elaboration: agriculture, and especially western Canadian agriculture, has been a hazardous industry. Unless steps are taken to restore the position of agriculture, nearly two million people in western Canada may remain in the low-income group, a condition obscured or relieved during the war of the 1940's but not permanently cured. While electricity on the farm may never be rated as one of the prime factors in the agricultural economy of Manitoba, it can nevertheless be most important in promoting the contentment and well-being of those on the farms in spite of the difficulties of market and climate.[2]

[1]The definition of a farm, it must be pointed out, varies in different countries. In Canada the Census defines a farm as land consisting of at least one acre farmed by one person and with an annual production of at least $50 worth of agricultural commodities. In the United States tracts of three acres and up and yielding at least $250 worth of products are defined as farms.

[2]The reader who is familiar with the recent history of western agriculture may prefer to turn to Chapter III at once.

The Dominance of Agriculture

The people of the Province of Manitoba must be ever alert to investigate all possible means for relieving the depressed conditions of agriculture. This is because the entire province is greatly dependent upon agriculture for its economic welfare. Indeed, it was this dependence upon agriculture which after 1929 forced Manitoba to endure economic distress in greater degree than most other areas in the Dominion.[3] For example, in 1931 this province had 6.75% of the people of the Dominion, but since 1928 its share of the national income averaged less than 5%, or about two-thirds of its share of the national population. Stated in another way, Manitoba has a share of the population of Canada that in 1935 was one-half again as large as its share of the income of the people of Canada.

The income of the people of Canada in 1935 was only two-thirds of the income in 1926. This means that for every $100 received in 1926, the people received only $66 in 1935. But in Manitoba the decline was from $100 in 1926 to $49 in 1935. No other province except Saskatchewan suffered so great a decrease. In Ontario and Quebec, for example, the relative decline in income was only to $76 and $70, respectively.

This disproportionate decline in income in relation to the population may be traced to the sharp decline in the position of agriculture. In 1926 agriculture was the pre-eminent productive activity in Canada. In that year the value of agricultural production was $1,400 millions. In the same year the value of manufacturing production was $1,200 millions. By 1935 agriculture had lost its position of leadership by a wide margin. In that year the value of its production had declined to $623 millions. In contrast the income from manufacturing had declined only to $950 millions. Thus for every $100 of Canadian agricultural production in 1926 there were only $44 in 1935. In contrast $79 was received from manufacturing in the latter year, $99 from mining, and $73 from forestry.

During this period in which the value of agricultural production of all Canada declined from $100 to $44, the decline for Manitoba was to a lower figure of $29. Thus, on the average the farmers of Canada lost $56 out of every $100 of their 1926 income, whereas in Manitoba they lost $71. The loss to Manitoba farmers was greater than in any other province. Thus, of all the major industries in Canada, agriculture suffered by far the most severely, and the greatest decline of agriculture occurred in Manitoba and Saskatchewan.

In comparing the two decades, 1919-1928, a period of general prosperity, and 1929-1938, a period of general depression, we find that the people of Quebec and Ontario actually received 4.7% and 1.8% more income, respec-

[3] See *Manitoba's Case*, Submission to Royal Commission on Dominion-Provincial Relations, 1937. Part V.

tively, in the "depressed" decade than they did in the preceding prosperous decade On the contrary, the income of Manitoba's people declined in the two decades by over 15%.[4]

Moreover, Manitoba's dependence on a depressed agriculture has prevented her from sharing in the economic recovery of other areas. In 1940 manufacturing in Canada "was brisker than in 1939 and, except in the Prairie Provinces, was also more active than in any other year of record, in the Prairie Provinces the latest index was lower than that for 1929."[5] This is evidenced by Table I

TABLE I. INDEX NUMBERS OF EMPLOYMENT, 1926-1940

	(1926=100)					
	Maritime Provinces	Quebec	Ontario	Prairie Provinces	British Columbia	All Canada
1926	100	100	100	100	100	100
1929	115	118	123	126	111	119
1939	110	121	114	103	108	114
1940	122	128	129	109	113	124

Source: Canada Year Book, 1941, p 658.

This comparative stagnation in the West and in Manitoba expressed itself further in a low rate of population growth From 1931 to 1941, while population in Canada increased from 10,376,786 to 11,420,084, or 10.2%, the population in Manitoba rose only modestly, from 700,139 to 722,447, or 3.18%. The five census districts of the southwestern section of the province all showed declines In 1931 Manitoba's population was 6.75% of that of the Dominion, by 1941 the figure had declined to 6.33%. The decline occurred not only in certain rural areas but also in many of the urban communities The cities collectively increased from 258,769 to 260,284, or only 1,515 souls, a modest one-half of one per cent.

Although 45% of Manitoba's people live in villages, towns, and cities, they too were dragged down with the decline of agriculture because, directly or indirectly, their jobs and incomes depend almost wholly upon agriculture. Perhaps the welfare of no major city in the world is so closely dependent upon the prosperity of the surrounding agricultural area as is Winnipeg This dependence is amply demonstrated by figures published by the Dominion Bureau of Statistics.

Although Winnipeg is the fourth largest city in the Dominion, it showed little or no recuperative power in the late 1930's, when recovery occurred elsewhere, and is the only large city in the Dominion which experienced a decline in population between 1931 and 1941 Employment by 1939 in most of the major cities of the Dominion exceeded the figure for 1926, in Winnipeg job opportunities were 6% lower in 1939 than they were in 1926. By 1940

[4] *Canada Year Book*, 1941, p. 797.
[5] *Ibid*, p. 658.

employment in other cities was from 15% to 61% above that of 1926. In Winnipeg employment had increased by no more than 1%.[6]

The great dependence of the urban communities, especially the Winnipeg area, upon the prosperity of agriculture is suggested by another significant fact. In 1940 Manitoba's income as assessed for income tax purposes was 4.72% of the Canadian income, while the population was about 6.39%. Furthermore, income tax collected in Manitoba was only 2.91% of the Dominion total, and of the amount received by the Dominion Treasury from the special 5% tax on interest and dividends Manitoba citizens paid only 2.8%

The foregoing facts and figures are recited for one purpose only to show the extreme dependence of Manitoba's citizens as a whole upon the rise and fall of Manitoba's agriculture.

The Winnipeg area enjoys a rather well-diversified economy It has nearly seven hundred manufacturing establishments, it does a vast amount of wholesale and retail business. Other service trades are well developed. Transportation, finance, and other industries make their contribution. In fact, the province as a whole has a distribution of employment which does not differ greatly from that of the Dominion as a whole, as may be seen from Table 2.

TABLE 2—PERCENTAGE DISTRIBUTION OF GAINFULLY EMPLOYED PERSONS IN CANADA AND MANITOBA, 1931

Industry	Canada	Manitoba
Agriculture	28 3	34 5
Fishing and logging	2 3	1 7
Mining and quarrying	1 5	0 6
Manufacturing	19 1	8 2
Construction	5 2	4 7
Transportation	7 7	7 8
Trade	8 0	9 1
Finance and insurance	0. 9	1 0
Service	10 2	6 6
Clerical	6 1	7 0
Labourers	11 1	9 9
Totals	100 0	100 0

Source Canada Year Book

One might expect, therefore, that even though agriculture was depressed, the other industries and occupations might make for some measure of prosperity, as has been the case, apparently, in central Canada. This expectation, significantly, is not realized in Manitoba precisely because of the intimate dependence of manufacturing, trade, and service occupations on the prosperity of agriculture. Urban life in Manitoba might be said to have little economic existence independent of agriculture. Rather it serves agriculture. But when agriculture is depressed, it too is depressed. This accounts for the fact that even though 45% of the Manitoba population is classified as urban,

[6]*Canada Year Book*, 1941, p. 659.

as against 53.7% for the Dominion as a whole, the urbanites of Manitoba are more dependent upon what happens to agriculture in Manitoba than are urban people in eastern Canada upon the fate of eastern agriculture. Farmers of Manitoba will find that all enlightened citizens of Winnipeg and other urban communities will make the farmers' problems their own and co-operate in evolving an effective solution.

Difficulty of Adjustment to Foreign Markets

Manitoba's heavy reliance upon foreign markets and the fact that the climate is none too well suited for diversified agriculture are further factors which are responsible for agricultural disabilities.

Manitoba and the West are peculiarly dependent upon the national policies of Canada and its international relations. Whereas Canada, exclusive of the prairie provinces, sends abroad only about 10% of its total production, the prairie provinces export to foreign countries about 45% of the value of their net production, a proportion as high as, if not higher than, that of most important producing areas of the world. For Manitoba the proportion of total production exported is about half of the average of the prairie provinces, that is, about 22%. But because the business of the elevator companies, grain concerns, transportation agencies, and many other auxiliary services in Winnipeg depends not only upon the grain trade of Manitoba but also upon that of Alberta and Saskatchewan, Manitoba, including Winnipeg, is really more heavily dependent upon the export trade than this figure of 22% would indicate.

In spite of a large urban population and some development of mining, forestry and other industries in Manitoba, agriculture still remains the most important economic activity. Yet the general pattern of Manitoba agriculture has never become fixed, but has been the victim of forces beyond its control. The fifty years prior to the first World War were characterized by settlement, expansion, railroad construction, and buoyant incomes, with adequate job opportunities.[7]

Just as agriculture in Manitoba was about to consolidate the progress made during the period of settlement, to eliminate uneconomic development, and to reach out for a permanent agricultural economy, the first World War took place. Manitoba along with western Canada was thrown into a strenuous productive effort. The hysteria of settlement was followed by the fever of wartime inflation. After three or four years of uncertainty and some readjustment, Manitoba along with the rest of the West was again thrown into a period of expansion, the effect of the North American boom of the 1920's.

The collapse of the 1930's brought the lowest price for wheat on record. A large part of this decline was coincident with, and caused by, the world-

[7]The material in the balance of this section is based in part upon H. C. Grant, C. B. Davidson, and J. E. Chernick, *Agricultural Income and Rural Municipal Government in Manitoba*, Economic Survey Board, Winnipeg, 1938.

wide depression in business. Added to this there was a growing overexpansion in wheat acreage throughout the world, which was not recognized until about 1928 or 1929. Western wheat growers have come to suffer seriously from the fact that wheat is one of the few crops which can grow in almost every country of the world, with a precipitation range from 10 or 12 inches up to 55 or more inches per year. Cotton, corn, flax, and many other crops are less adaptable. The drive for self-sufficiency among the European countries during the depressed 1930's, coupled with this adaptability of wheat growing to nearly all areas of the world, has been the nemesis of the western wheat grower.

Thus in the past forty years, changes and economic upheavals followed each other so fast that adjustment to them (in the light of hindsight) was always late and imperfect. At no time in this period is there any extended number of years which might be regarded as a norm toward which the economy might be consciously encouraged to conform. During most of this period, and over the greater part of the world, there was great instability of monetary and commercial policies and unpredictable reversals of trend in international capital movements. It was during this period that the West became settled and became a major world food-surplus-producing area.

This instability of agriculture is the fundamental force influencing the total economy of Manitoba. The production of most of the chief farm products in the West far exceeds the absorptive capacity of the Canadian market. The principal contact of Manitoba and other western provinces with international markets is in connection with wheat, oats, barley, rye, cattle, and hogs. International price levels largely determine the value of these products not only abroad but also at home.

To Canada these export surpluses are an advantage. They build up foreign exchange and draw capital and finished goods to this country. When exchanged on a fair basis they are also advantageous to Manitoba. However, the flow of wheat from the prairie provinces acts as a conductor which transmits back to the West the stresses and strains of political and economic conditions prevailing in the rest of the world. In many respects western Canada is an unusually accurate barometer of economic, political, and social developments in the world at large, these developments acting and reacting upon the flow of wheat from Canada to other countries.

> It may be said, commercially speaking, that western Canada is a part of Europe. Western Canada cannot live unto itself and will not survive without free access to the great consuming markets of western Europe. Western Canada has no choice. There is no discernible destiny for us other than that of being a surplus-food-producing area. Regional policies must be directed towards the conservation of our resources and their most productive and economic use. National policies should be directed towards minimizing the instability of western agriculture which comes to us from without, from conditions beyond our own control, from decisions and policies in whose making Canada has no voice.[5]

[5]Grant, Davidson, and Cherwick, *op. cit.*, p. 5.

While the above quotation is less true of Manitoba than of some other parts of the West it is a serious question whether the people of Manitoba should ever attempt to insulate themselves against these world forces. This Commission believes that the drift toward self-sufficiency and isolation in international affairs does not constitute a permanent solution to the world's problems It believes rather that the solution to Manitoba's problems must be sought in factors which will encourage a more rounded agriculture and create a more workable balance between the urban and rural economy of the province (The evidence for considering electric power as among these factors will be set forth in Chapters III and IV)

Climatic Factors

In addition to the instability of western agriculture, resulting from its major dependence upon international markets, the natural conditions under which farming is done in this area also make for instability and uncertainty

In western Canada agriculture is carried on under conditions which are not conducive to steady yields. It is based upon a minimum of precipitation, ranging from an average of 14 inches in some parts to a high of 21 inches in others. In Manitoba the range is from an average of about sixteen inches in the southwest and 10 inches in the southeast to 21 inches in the interlake district [9]

Because of the relatively light rainfall on the average Manitoba farm, any slight departure from the average precipitation especially during the growing season, is likely to produce wide variation in crop yields. Since 1926 the average yield of wheat in Manitoba has ranged from 22.8 bushels per acre (1926) to as low as 9 bushels in 1935 Within two successive years the yield may rise or fall by as much as 50% for the province, particular areas within the province experiencing even more extreme variations. Thus in addition to the price disturbances, Manitoba farmers are subjected to the whims of the weather cycle

Another factor limiting the flexibility of agriculture in Manitoba is the relatively short growing season Killing frosts may occur in every month of the year and are frequent as late as June. The average date of the last heavy frost of spring is about the fifteenth or twentieth of May in the southern half of the province. The first heavy frost of autumn falls in the last week of September south of the lakes, except east of the Red River and the western portion of the Souris River district In these districts it falls in the second week In the interlake region the average date is in the third week of September

The average length of the frost-free period (33° F) is about 100 to 105 days in the southern portion of the province, except in the southwest section, where it is more likely to be 85 or 90 days. Making the criterion of a killing

[9] See A J Connor *The Climate of Manitoba*. Economic Survey Board, Winnipeg, 1939

frost 29.5° F., the above figures for average frost-free periods are increased to about 135 days and 120 days respectively ("Averages" are somewhat deceptive, being composed of many annual recordings, about half occurring earlier than the average and about half occurring later than the average.)

Thus growing season temperature conditions place a strict limit on the facile raising of fruits and vegetables, offset somewhat by the relatively long daylight period in the summer months. The farmer has become, almost inevitably, primarily a grain farmer.

Conclusion

In a dynamic world economic activities must undergo a constant process of adaptation, if they stagnate they are likely to be left badly adjusted in terms of both cost-price relationships and desired type of product or service. The Manitoba economy has been subjected to an unusual array of disturbances, and the march of change is likely to continue. For this reason every effort must be made to encourage developments which will further the adaptive process. The Commission takes the view that electric power on the farm, while no panacea, is an indispensable weapon with which the Manitoba farmer can facilitate the adaptive process and which will bring about better co-ordination between urban and rural activities in the Province of Manitoba.

CHAPTER III

THE ADVANTAGES OF A DIVERSIFIED ECONOMY

Manitoba's Progress in Diversification

Chapter II analyzed the difficulties that stand in the way of a stable, prosperous Manitoba economy. The extreme dependence of both rural and city dwellers upon the price and yield of wheat and other field crops has been emphasized. Evidently prosperous urban areas depend upon prosperous farmers.

Nevertheless, it must be emphasized again that the people of Manitoba, while greatly dependent upon grain, have made a vigorous effort to broaden the base of their entire economy. In 1937 of all the income received by individual enterprisers (business, trade, professions, etc.) in Manitoba, 73% came from agriculture, as opposed to a figure of 55% for the Dominion as a whole; in 1940 the figures were 65% for Manitoba and 57% for Canada.[1] Retail and wholesale trade, service industries, professional services as well as other sources of enterprisers' income, while not as important economically in Manitoba as in Canada as a whole, nevertheless showed substantial development and in some instances contributed as large a proportion of the total Manitoba income as of the total Canadian income.[2]

If we compare the distribution of sources of salaries and wages for Manitoba and Canada we find a similar trend. Agricultural labour accounted for 4.5% of all salaries and wages in Manitoba in 1937, while the figure for Canada was 2.7%. For 1940 the figure for Manitoba was 3.9% and that for Canada 2.7%. Mining, forestry, and manufacturing were about 38% more important as a source of salaries and wages in Canada than in Manitoba both in 1937 and 1940.

In both 1937 and 1940 wages and salaries in transportation and public utilities were proportionally a substantially more important source of income in Manitoba than in Canada as a whole. This was also true of retailing, wholesaling, and service industries in both 1937 and 1940, strange as it may seem. Likewise in the case of banking, life insurance, and professional services (employees only) wages and salaries loomed larger in the total income of Manitoba workers than was the case in Canada as a whole.[3]

In short, while manufacturing is the one important sector of the economy underdeveloped in Manitoba relative to Canada as a whole, the fact is that Manitoba has the beginnings of a well-balanced economic system. If this

[1] Data from Royal Commission on Dominion-Provincial Relations, Report on National Income.

[2] See Appendix at end of chapter, Table A.

[3] See Table B, Appendix to this chapter.

trend can be further encouraged and some of the weaknesses of agriculture can be removed, it is probable that the economic position of the people of Manitoba will be fundamentally improved. That some improvement in this direction can be made in the next decade is within the realms of possibility.

Progress in Broadening the Base of Agriculture

Not only has the Manitoba economy as a whole become somewhat more balanced, but the diversification of agricultural output has also experienced a substantial impetus. There are, however, economic and climatic difficulties which retard the progress of this movement. The shift to sheep or hog raising, for example, requires considerable capital investment in equipment and breeding stock. If diversification becomes at all widespread, the danger of oversupply and low prices may arise. Apart from the danger of adverse prices in the developmental period, the western producer would be forced to sell in distant markets, requiring long and expensive hauling. The transportation charges for bringing the product to the door of consumers in Europe or even in eastern Canada would represent a major deduction from the price actually received by the farmer and might force him to operate at a competitive disadvantage. Up to the 1930's grain and especially wheat were the chief products able to bear freight costs and still yield the farmer a return above his fixed and operating costs. In many instances, the western product may suffer some physical or technical deterioration in the handling and hauling over the long route from farm to consumer. Wheat and other grains are, again, the type of product which suffers no deterioration in transit.

There are other disabilities. For example, the southwestern section of Manitoba, though substantially settled, suffers a deficiency in rainfall in many years. Grain raising is about the only type of farming practicable in such an area. Even cattle ranging is hazardous. In the case of grain farming the current investment is not great; the seed, oil and fuel for the tractor and some labor items are about the only substantial costs which would be lost in case of rainfall shortage. However, if the farmers had shifted to mixed or dairy farming and then were confronted with a rainfall deficiency, the losses and difficulties would be much greater. Either the livestock would have to be shipped out in large quantities to areas with adequate moisture, or great quantities of feed and water would have to be secured and brought into the area. Whether such feeding operations could be carried on successfully is doubtful, except in years when livestock and dairy prices are unusually high and feed prices unusually low—a combination which rarely occurs.

However, despite the difficulties attending the shift to a more diversified agriculture, the movement in that direction has been unmistakable. Even a cursory examination of the statistics on agricultural production reveals that since the first World War the proportion attributable to field crops has declined considerably.

The two following tabulations, one beginning in 1918 and the other in 1920 and recorded in five-year intervals, demonstrate clearly that even before the great collapse in the world prices of grain in the 1930's a trend away from field crops had commenced. The following tabulation indicates steadily less reliance on field crops.

1920-1924	79 8%	1918-1922	82 7%
1925-1929	72 0%	1923-1927	75 5%
1930-1934	61 8%	1928-1932	65 1%
1935-1939	66 4%	1933-1937	57 5%

This trend to diversification has continued to the present with a slight reversal in the last five-year period due to the conjunction of an extraordinarily large yield and improved prices in 1937.

If we compare the sources of agricultural income of Manitoba and Canada as a whole we see further evidence of this wholesome trend. While wheat still bulks large in Manitoba agriculture, there is a substantial concentration on other field crops. Sugar beets, flax, rye, and barley are relatively more important in Manitoba than in Canada as a whole. Livestock as a source of income in 1940 was also relatively more important in Manitoba than in Canada as a whole.[4]

Thus it is obvious that Manitoba has been moving in the right direction with regard to diversification; the trend is there but it needs further encouragement.

Instability of Income under One-Crop Farming

Economists have frequently pointed out that a family can adapt itself much more readily to a uniformly low level of income than to a high but fluctuating and uncertain income. During a few years of good incomes the eternal optimism of the human being leads him to make commitments and to adopt a scale of living which cannot be maintained when these temporary high incomes subside. Painful readjustments follow.

Manitoba farmers, and therefore many town and city dwellers as well, have been victims of violently fluctuating incomes. They suffer (1) because of the fluctuations in total income due to the dependence upon agriculture and (2) even more so because their agriculture is concentrated in wheat.

From 155 million dollars in 1928 the gross agricultural production declined to 89 million dollars in 1930, and in four years in the 1930's it was about one third of the 1928 figure. This extreme erraticism is traceable to the yield and price of field crops. For example, the gross production of field crops in 1928 was 113 million dollars, three years later it declined to less than 25 million dollars, or by 78%. In this same three-year period the gross production of all other farm produce declined by only about 41%, suggesting the advantage of the multiple-product system.

[4]See Table C in the Appendix to this chapter for these figures and others of equal interest.

The gross income of farmers, of course, depends on yield times price. In the thirty year period 1908-1937 the value of an acre of wheat fluctuated from a low of $4.39 (1931) to a high of $34.34 (1917). In eight years of the period the value of the crop was less than $10 per acre, in fourteen years it was between $10 and $20, in five years between $20 and $30, and in three years over $30. The bulk of farm costs, such as taxes, interest, depreciation, and transportation, are relatively fixed regardless of cash income. For this reason the net income available to the farmer for living expenses fluctuates even more violently than does gross income.

The greater stability of the diversified sources of income is revealed in Table 3.

TABLE 3—INDEXES OF GROSS AGRICULTURAL PRODUCTION IN MANITOBA FOR SELECTED YEARS, 1926-1937 (1926=100)

Product	1926	1929	1931	1935	1937
Field crops	100.0	70.5	22.2	51.2	81.2
Farm animals	100.0	138.1	65.5	69.2	92.2
Wool	100.0	142.1	52.6	63.3	107.0
Dairy products	100.0	90.5	70.5	66.6	83.9
Fruits and vegetables	100.0	94.9	93.1	122.3	107.3
Poultry and eggs	100.0	158.0	81.5	62.7	64.5
Fur farming	100.0	316.9	165.3	340.7	555.9
Clover and grass seed	100.0	137.9	300.0	451.7	1575.9
Honey	100.0	155.7	97.7	67.8	118.2

These figures show that in 1929, when the gross production of field crops was down about 30% from 1926 and 1928, the gross production of all other major sources of farm income except dairy products, fruits, and vegetables had actually increased. Even in 1931 and 1932, when Manitoba farm income hit an all-time low in the present generation, two sources of income actually show substantial increases over 1926. By 1937, while incomes from field crops were still nearly one-fifth under the 1926 figures, the gross production of wool, fruits and vegetables, furs, clover and grass seed, and honey, that is, five of the nine major sources of farm income, showed improvement over 1926. However, it must be recognized that most of these relatively stable sources of income have never played a large role in total income. Thus, even though the dollar production of clover and grass seed in 1931 was three time greater than in 1926, this one source accounted for less than one-half of one per cent of total production in that year.

From 1926 to 1929 the income from the sale of field crops (in contrast to gross production discussed above) declined by one-third, in the same period the receipts from livestock and animal products increased by 19%, thus offsetting to some extent the decline in field crops. The income from the sale of field crops declined from 1926 to 1931 by over 80%, in this same period the decline in income from the sale of livestock and animal products was less than 25%. Diversification lends some stability.

Manitoba is indeed fortunate in the extent to which agriculture has become diversified. If practical the process of shifting to lines other than

grains should receive major encouragement from the government, the University of Manitoba, and other research agencies, as well as the farmers themselves. Even in the extreme drought area of southwestern Manitoba some shift from wheat may be justified. Professor J. H. Ellis, in his excellent study, *The Soils of Manitoba*, says:

> During the recent long drought period in southwestern Manitoba, corn, millet and winter rye in most cases gave some returns even though most grain crops were a failure. The acreage devoted to the production of feed on the average farm in the plains area in Manitoba is very inadequate, and while sweet clover and grasses may be sown when soil moisture is favourable and grasshoppers are not a menace, years may be expected when clover and grasses will fail for various reasons. Hence an acreage of corn, millet and winter rye should be sown each year, sufficient to ensure some feed, and preferably in quantities that will ensure a carryover as cured feed or silage.[5]

Greater Consumption on Farms of Farm Products

Another advantage of diversified farming which has not yet been mentioned is the greater reliance of the farm family on home-grown and home-processed foods. A generation ago few wheat farmers had any livestock other than horses, no poultry, and raised no vegetables or fruits. All this has largely changed, at least in Manitoba. By 1936 very few farmers were confining their activities to grain growing. Out of a total of 57,774 farms in Manitoba, over 49,000 reported having nearly three-quarters of a million cattle with an average of 15 per farm, as is indicated in Table 4. Similarly it may be seen that there is an extensive population of milk cows, sheep, swine, poultry, and bees.

Table 4—Livestock on Manitoba Farms, 1936

	No. of Farms Reporting	Total Animals	Average per Farm
Cattle	49,399	747,367	15
Cows milked	47,048	293,735	6
Cows and heifers in milk or in calf	48,800	346,105	7
Sheep	6,056	207,915	34
Swine	34,874	269,708	8
Poultry	45,324	4,730,059	102
Hives of bees	2,940	32,924*	11

Source: Census of Prairie Provinces, 1936, p. 268.
*Hives.

The census of 1941 reports 814 fruit and vegetable farms scattered throughout the province but centred chiefly in the Winnipeg area. This type of farm includes those which produced for sale in 1940 either vegetables (other than potatoes and turnips), vegetable seeds, nursery products, greenhouse products, or small fruits to the value of $50 or more, and farms where there were 50 fruit trees or more in 1941.

Dean A. M. Shaw, formerly of the University of Saskatchewan, urges that "poultry, mainly chickens and turkeys, be given first consideration on the grounds that climatic conditions are suitable, they can be kept with profit

[5] *The Soils of Manitoba*, Economic Survey Board, Winnipeg, p. 32.

on every farm, they furnish suitable and readily available products in the form of eggs and meat for the farmers' table, they utilize much material that could not profitably be consumed by any other kind of livestock."[6]

As will be shown in the next chapter, electricity is much more useful on a diversified farm than on a one- or two-crop farm. While diversification has made progress, this Commission is of the view that electricity on the farm will not only hasten diversification but will enable the farmer to take better advantage of such diversification as already exists, both for his own consumption and for the growing and preparation of farm produce for sale. As Robert England states:

> It is claimed by some that there is over-expansion in farming as a business and hence this business of providing food should not be asked to absorb more workers. There is a fallacy in much reasoning of this character. The pioneer farm with its woodlot is more than a business enterprise supplying food to urban centres. It supplies also shelter, fuel and food cheaply to the settler's family, and if these were changed into a budget, the whole matter would be seen in another light.[7]

Soil Conservation and Mixed Farming

"Generally speaking, the people of this province have not taken a great deal of interest in soil conservation."[8] There has been some "mining of the soil," as a result of which some areas have lost their productivity and have been partially abandoned; others have become less productive even during years of adequate precipitation.

Diversified farming and crop rotation generally reduce the depletion of the top soil. Since different crops withdraw varying combinations of soil constituents in the growth period, a sound policy of crop rotation is less likely to lead to deficiencies in any one constituent such as nitrogen or phosphorus. Furthermore, in the case of mixed and dairy farming, substantial quantities of natural fertilizers are produced which may be spread back upon the fields, thereby vast quantities of organic and mineral materials are returned to the soil, instead of the farming process involving only a constant "mining" of the soil.

Problems of Irrigation, Lawn, Garden and Field Crops

Wherever farming has become a permanent and settled way of life as well as a commercial enterprise, attractive farmyards with growing trees, shrubbery, flowers, and grass abound. These not only appeal to the esthetic nature of man, but encourage a pride in the home and give life a glow and a warmth which even city dwellers frequently do not enjoy. In many parts of Manitoba where drought and long hot spells may occur, the difficulties of cultivating vegetation about the farm buildings are real and constitute a sufficient explanation for the lack of attractive surroundings in some parts of the province.

[6] See Robert England, *The Colonization of Western Canada*, p. 285.
[7] *Ibid.*, p. 135.
[8] H. C. Grant, C. B. Davidson, and J. E. Chernick, *op. cit.*, p. 8.

Vegetable gardens probably are now more prevalent on Manitoba farms than ever before. However, some farmers still do not raise any vegetables for home use, and most of them do not produce as many as they could and should. As in the case of flowers, grass, and shrubbery, the deficiency in vegetable gardens is traceable to climatic factors, especially the uncertainty of rainfall in the growing season.

Dug-out on Farm for Water Supply

If the farmer had sufficiently cheap power to pump water from an adequate water source, he not only would become somewhat more self-sufficient but would be in a better position to beautify his home. A simple, cheap, and expedient method of assuring an adequate water supply in most areas has been suggested by Professor Ellis.[9] These are his words:

> The water conservation work that should be largely developed is the installation of dug-outs in retentive soils, or of individual dams in run-ways to impound run-off water for domestic or stock use, and for the irrigation of the garden.

Professor Ellis goes on to make several highly pertinent suggestions for improving on present practices in building water-retention systems. He suggests that:

> ...stead of building a dug-out in every one of the size covered by the Prairie Farm Rehabilitation Act grant, a dug-out should be large enough to ensure a good reserve supply of water, so that the water may be used to irrigate a garden. Where the dug-outs are excavated by dragLines, the excavated earth is dumped in spoil banks along the edge of the excavation. These spoil banks should be removed from the edge of the dug-out and used for the construction of a low dyke one or two feet high around an area immediately adjacent to the dug-out, so that the space between the dug-out and the raised dyke can be used for a garden.

A significant reference is then made to the possibilities of utilizing power for the purpose of increasing the efficiency of irrigation systems:

> If the dug-out is of sufficient size, the water may be used periodically for the irrigation of the garden by the installation of a pump.

This suggestion by Professor Ellis merits widespread adoption. The role which electric power would play in such development needs no further comment.

Whether general irrigation for some field crops is practical on any widespread basis is a subject beyond the scope of this Commission. Commercial irrigation in Alberta and in the United States has not been an unmitigated

[9] J. H. Ellis, *The Soils of Manitoba*. Economic Survey Board, Winnipeg, 1938.

success. Where the yield per acre can be increased annually to $100 or more, irrigation may be practical. Vast quantities of water must be available. The Commission is informed that some inquiries have been made on this matter and that only limited, favourable results may be expected in the future. To be practical, however, such projects require, besides adequate water supplies, sources of cheap power for pumping

Dugout on Farm with Spoil Levelled and Graded for Garden

Summary and Conclusions

Manitoba agriculture has become more diversified. Exclusive grain farmers have become fewer. In spite of this wholesome trend farm incomes are still erratic and unduly low. The Commission believes that if the advantages of diversification were more fully understood by all concerned, combined efforts might result in greater stability and certainty of income, as well as higher net returns.

But this raises the question of whether even a diversified economy could withstand the shock of another period of depression such as characterized the decade of the 1930's. In attempting a reply to this question which, of course, cannot be answered definitely at the present time some optimism seems justified. There appears to be a firm conviction in official circles, both in the United States and Canada, that the deflation of the 1930's dare never, and need never, be repeated. In the United States in particular the view has been developed that central government through banking policy, treasury policy and a public works programme, has the power to sustain reasonably full employment. If the United States experiences full steady employment, it is probable that Canada will not only benefit thereby, but that it will adopt similar policies to create more widespread employment opportunities.

The depression of the 1930's was so injurious to the West because a collapse of both international trade and domestic industry occurred simultaneously. Thus even if international trade is not restored to the level of the 1920's but on the other hand domestic employment is maintained, the Manitoba agricultural situation will not revert to the 1930 level. Some may argue that this puts the cart before the horse—that domestic activity depends on international trade. The modern view, however, is that international trade and international relations themselves are largely a reflection of domestic activities of a few large nations. That is, if domestic prosperity can be main

tained, international trade and international relations may be put on a much sounder basis. There is a close relation between industrial payrolls and the price of domestically consumed farm products, both in the United States and Canada. The parallel is indeed striking. Thus, if prosperity is retained after the war this will probably be accompanied by reasonably satisfactory prices for pork, beef, dairy, and many other products. This in turn will call for large quantities of feed and help sustain the price of fodder and grains.

Thus the Manitoba agricultural situation, while dark in the last decade and a half, in terms of the calculable future rests on a more sound foundation than at any time in the last fifteen years.

The above analysis rests on certain suppositions, whether they are realized remains to be seen, but they are reasonable assumptions. The programme of rural electrification, involving the expenditure of millions of dollars, must be predicated upon some assumption as to the type of farming and the probable degree of farm prosperity. It is against this background that the Commission carried out the task assigned to it.

TABLE A—INDIVIDUAL ENTERPRISERS' INCOME

Source of Income	1937				1940			
	Canada		Manitoba		Canada		Manitoba	
	In Thousands of Dollars	In Per Cent	In Thousands of Dollars	In Per Cent	In Thousands of Dollars	In Per Cent	In Thousands of Dollars	In Per Cent
Agriculture net income after depreciation	422 481	54 72	51 243	73 32	508.766	56 68	39.238	64 75
Fisheries	14.768	1 91	868	1 22	14,249	1 59	788	1 3
Merchandising proprietor s earnings								
Retail	127,548	16 52	6,281	8 86	140,403	15 64	6.490	10 71
Wholesale	14,645	1 9	1,272	1 8	16,618	1 85	1,494	2 47
Services	43,814	5 69	2,418	3 41	47,727	5 32	2.498	4 12
Professional	82,933	10 74	4,837	6 83	92,686	10 33	5,264	8 72
Construction	9,706	1 27	380	54	12,360	1 38	570	94
Net income from keeping lodgers	41,486	5 37	2,649	3 74	47,019	5 24	3,199	5 28
Miscellaneous	15,009	1 94	809	1 28	17,718	1 97	1,058	1 71
Grand Total	772,090	100	70,852	100	897,540	100	60,599	100

Source Royal Commission on Dominion-Provincial Relations (Rowell-Sirois), Report on National Income

TABLE B—SALARIES AND WAGES

	Source of Income	1937				1940			
		Canada		Manitoba		Canada		Manitoba	
		In Thousands of Dollars	In Per Cent	In Thousands of Dollars	In Per Cent	In Thousands of Dollars	In Per Cent	In Thousands of Dollars	In Per Cent
1	Agricultural labour	66,570	2 73	6,580	4 51	81,335	2 66	7,008	3 89
2	Primary mining*	121 398	5 98	3,809	2 68	143,206	4 68	3,924	2 15
3	Primary forestry	58,480	2 4	300	34	66,490	2 17	500	27
4	Manufacturing	757,521	31 09	29,887	20 51	973,130	31 82	36,093	19 77
5	Construction done by private contractors	107,457	4 41	3,515	2 41	146,746	4 8	7,454	4 08
6	Steam railways	202,378	8 3	24,149	16 57	224,503	7 34	26,120	14 3
7	Electric railways	19 778	81	1,424	98	20,754	68	1,441	79
8	Water transport	30,240	1 24	400	27	28,350	95	400	22
9	Telephone companies	25,580	1 05	1,422	98	27 117	89	1,492	82
10	Merchandising, retail*	235,758	9 67	16,676	11 44	257,317	8 41	17,232	9 44
11	Merchandising, wholesale	127,373	5 23	14,545	9 98	148,122	4 78	17,101	9 36
12	Merchandising, services*	56,148	2 30	3,790	2 6	61,.35	2	3,9.6	2 14
13	Federal government, civil*	99,777	4 09	6,847	4 01	123,168	4 03	6,821	3 74
14	Provincial government	66,880	2 74	3,385	2 32	72,543	2 37	3,841	2 11
15	Municipal education	68,988	2 82	4,057	2 78	69,330	2 27	4,500	2 46
16	Other municipal activities	53,002	2 18	3,058	2 10	55,876	1 83	3,148	1 72
17	Chartered banks	35,220	1 45	2,233	1 54	37,822	1 24	2,328	1 27
18	Life insurance	36,648	1 46	2,303	1 56	35,830	1 17	2,224	1 22
19	Professional (employees only)	86,264	3 57	6,255	4 29	97,056	3 17	6,333	3 74
20	Miscellaneous	156,246	6 44	9,915	6 8	186,520	6 10	11,320	6 2
21	Workmen's compensation benefits	19,616	81	603	61	20,083	66	1,079	59
22	Military pay and dependents' allowances	10,490	43	1,018	70	189,192	5 98	17 700	9 72
23	Total salaries and wages	2,437.060	100	145,782	100	3,058,193	100	182.625	100

*Includes North-west Territories
Source: Same as Table A

Table C—Receipts from the Sale of Farm Products

Source of Income	1937				1940			
	Canada		Manitoba		Canada		Manitoba	
	In Thousands of Dollars	In Per Cent	In Thousands of Dollars	In Per Cent	In Thousands of Dollars	In Per Cent	In Thousands of Dollars	In Per Cent
1 Grains, seeds, and hay:								
Wheat	149,535	23 34	34,588	46 7	193,293	27 04	21,194	35 1
Oats	16,454	2 57	2,515	3 4	14,037	1 96	692	1 15
Barley	17,686	2 75	7,592	10.27	9,838	1.38	2,602	4 31
Rye	1,591	25	942	1 27	1,630	23	324	.54
Flax	872	14	356	48	2,404	34	524	87
Corn	297	05			324	05		
Clover seed	510	08	*		650	09		
Hay and clover	4,604	72	1,493	1 76	1,460	20	122	20
Total grains, seeds, and hay	191,499		47,242		223,576		25,458	
2 Vegetables and other field crops								
Potatoes	13,897	2 17	274	37	15,299	2 14	347	57
Vegetables	12,408	1 94	*		15,614	1 9	*	
Sugar beets	2,825	44			4,648	65	644	1 07
Tobacco	16,802	2 62			12,079	1 69		
Total vegetables and other field crops	45,932		274		45,640		991	
3 Livestock								
Cattle and calves	94,786	14 79	9,035	12 22	101,721	14 23	10,977	18 18
Sheep and lambs	6,615	1 03	401	54	6,691	94	497	82
Hogs	90,286	14 09	3,990	5 4	118,703	16 61	8,409	13 93
Horses	5,304	82	209	25	1,375	.19	68	.1
Poultry	9,533	1 49	*		10,535	1 47	*	
Total livestock	204,524		13,635		239,025		19,946	
4 Dairy products								
Butterfat	50,405	7 87	4,493	5 96	51,036	7 14	4,670	7 74
Milk and cream	59,930	9 35	3,151	4 26	67,830	9 49	4,174	6 91
Total dairy products	110,335		7,574		118,866		8,853	
5 Fruits	22,306	3 48			17,986	2 52		
6 Other principal farm products								
Eggs	26,577	4 14	1,621	2 19	25,545	3 57	1,889	3 13
Wool	2,117	33	121	16	2,231	32	128	21
Honey	398	06	*		430	06	*	
Maple products	1,335	21	*	*	2,624	.37		
Total other principal farm products	30,417		1 742		30,860		2,017	
7 Miscellaneous farm products	14,240	2 22	2,519	3 32	15,450	2 16	2,265	3 75
8 Forest products sold off farms	14,640	2 29	*		16,580	2 32	*	
9 Cash income from fur farming	6,802	1 06	654	9	6,702	94	850	1 41
10 Grand total cash receipts	640,695	100	73,950	100	714,686	100	60,390	100

*Included in "Miscellaneous Farm Products"
Source Same as Table A

CHAPTER IV

THE ADVANTAGE OF ELECTRIC POWER ON THE FARM

Production consists almost entirely of the application of power to organic and inorganic materials. In the course of the development of agriculture, animal and wind power came gradually to supplement the energies of the farmer working by himself. In modern times, power originating in steam and oil has been added to the farmer's working crew. More recently still, electric power in many areas has come to be regarded as an indispensable aid to efficient farming.

That electric power may become a vitalizing factor on the farm was suggested to some extent in preceding chapters. We propose now to discuss in greater detail some of the major advantages that would accrue from the widespread extension of electric power.

Importance of Increasing Net Income of Manitoba Farms

Previous chapters have shown that Manitoba agriculture operates under several handicaps and disabilities. For this reason farmers must, at their peril, constantly promote new products, new methods of production and must take advantage of every modern development by exploiting it to the full. For the same reason it is imperative that Manitoba agriculture seek constantly to increase its output and reduce its unit costs if it is to play a dynamic, progressive role in the economy of Canada. Although electric power is by no means the solution to all these problems, this Commission holds the view that it may constitute an important weapon in the arsenal of tools available to the Manitoba farmer. This view is reinforced by the opinion and experiences of authorities in many countries where agriculture is highly developed.

In recommending to the Senate for approval the bill which later became the Rural Electrification Administration (R.E.A.) in the United States, the Senate Committee on Agriculture and Forestry reported that "Experience shows that nothing can be more beneficial to the farmers and that nothing will add more to the comfort, satisfaction and happiness of the rural population than the electrification of farm homes."[1]

A prominent authority writes,

> During the relatively short period of my lifetime I have seen drudgery practically disappear from factory life. Lifting by human labour, for instance, has practically gone. More and more workmen are paid for using their heads and operating controls. Of course, it takes a good deal of imagination to see this same influence working a transformation in agricultural life. But in what we do today we must have in mind that electricity is going to make possible changes of a very radical character. The benefits to agriculture in the next ten years may easily equal the benefits to industry during the past twenty years.

[1] John M. Carmody, *Annals*, Jan., 1939.

> The efforts of a strong man seem puny when measured against the tireless unceasing production of even a small electric motor. And yet we know that a small 1-kilowatt motor running for an hour does an amount of work that it would take the labor of thirteen husky men to equal. Th s efficient electrical slave frequently costs its master less than 5 cents an hour when working. Nor does it require bed and board when idle.[2]

Hon. T. Stewart Lyon, formerly chairman of the Ontario Hydro-Electric Power Commission states, "The value of this service to the farm population can scarcely be overestimated, particularly in regions such as old Ontario, where farm labor is scarce and costly."[3]

Danish agriculture has won the admiration of the world. Yet it was not always so. In fact agriculture in Denmark in the 1880's experienced a collapse as complete as that of western Canada in the 1930's. Prior to 1880 Danish farming concentrated largely on grain growing. The price of grain remained deeply depressed in the 1880's, so that farming became utterly unremunerative. Danish farmers were obliged to make a complete change-over with regard to crop production. V. Faaborg-Andersen, an authority on farm electricity, states, "Farmers were compelled to engage on a larger scale in the raising of root crops, using grain for feeding purposes, and to base their activities principally on the production of the processed products, bacon and butter."[4]

That electricity played a leading role in revitalizing agriculture in Denmark is attested to by the same writer in these remarks:

> The newest and best technique has always been promptly adopted in the service of production. Th s being so, the farmers have at an early date realized the potentialities of electricity as an excellent friend and ally in assisting them to solve and carry out the numerous tasks before them. The extensive use of electricity has proved to have been of great importance to agriculture.

Three Swedish authorities, in a report to the Third World Power Conference in 1938, discuss the effect of electricity on agriculture:

> It will suffice to state that rural electrification makes steady progress and that the number of electrified farms is increasing. This is a convincing proof of the fact that electrification is considered by farmers economically feasible. The most important achievement of rural electrification is undoubtedly the better distribution and intensification of farm work during the dark season, which is very long in Sweden, rendered possible by electric lighting. Electric motors and electric-heating appliances will have to fulfill analogous tasks.[5]

Testimony similar to that from the United States, Ontario, Denmark, and Sweden could be quoted at length from every important country of the world. Horse power came, but has largely gone, wind power played a role at one time. The gasoline engine too has lifted part of the load from man's shoulders. But the twentieth century is the era of electric power, in the factory, in the home, and on the farm—and in some areas even in the field.

[2] Rural Electrification Administration, Government of the United States, Release No. 25, August 10, 1935.

[3] Third World Power Conference, Washington, D.C., 1936, p. 807.

[4] V. Faaborg-Andersen, Ryes Danish Electricity Commission, Third World Power Conference, p. 491.

[5] Third World Power Conference, p. 710.

Uses of Electricity on the Farm

In considering the uses of electricity on the farm, we must shake off any preconceptions derived from our experience with electricity in urban homes. Unlike the city home, the farmstead is a miniature factory as well as a residence, with the result that electricity can be used for a much wider range of activities. Farm families are usually larger and frequently share their abode with farm employees. Clothes are washed at home instead of being sent to the laundry. The food supply for the year may be very largely grown, canned or preserved and stored on the premises. Frequently the farm woman materially augments the family cash income through the sale of food products produced on the farm and prepared for market in the farm kitchen. The need for electric power in other farm operations is equally great.

The Rural Electrification Administration has published a list of over 200 uses for electricity on the farm. Mr. Allyn A. Walters, in reporting recently that the R.E.A. has found about 125 additional uses since the list was published, said, "The use of electricity on the farm is limited only by the imagination of the farmer." Two million farmers with their sons and daughters in the United States already employ central station electricity, thus an enormous amount of interest, enterprise, and personal ingenuity on the farm, under almost all conceivable conditions, is constantly engaged in expanding the uses to which power and energy will be put. "Yankee ingenuity," which has made the American people "gadget-conscious," seems destined to play a great role in bringing about radical changes in farming techniques by steadily adapting electricity to new uses.

In order to give the reader some conception of the usefulness of electricity, the following classified list of uses is included.[8] Obviously no one person will ever employ energy for all these uses, yet somewhere at some time thousands are employing energy for all of these purposes and many others. Some of the uses may seem trivial, but in the aggregate they not only show the great flexibility of electricity but they also add up to a staggering total. Some of these appliances may never find use on Manitoba farms, nevertheless, the entire group of appliances and uses is included, because they clearly suggest that the labour-saving and the comfort-creating powers of electric energy are enormous.

USES FOR ELECTRICITY

I. Home Uses

For Health

Air conditioning
Artificial sunshine
Heating pad
Humidifier
Infra-red and ultra-violet lamps
Light for better vision
Milk-warmer
Refrigerator
Vibrator
Water heater
Water system
Water for drinking, cleanliness, and sanitation.

[8] From the R.E.A., T.V.A., and other sources.

Essential Home Services

- Cooking
  - Chafing dish
  - Coffee urn
  - Egg boiler
  - Fireless cooker
  - Frying pan
  - Grill
  - Hot plate
  - Oven
  - Percolator
  - Portable ranges
  - Pressure cooker
  - Range
  - Sandwich toaster
  - Tea kettle
  - Toaster
  - Waffle iron
- Dishwasher
- House heating
  - Automatic coal stoker
  - Electric heating system
  - Electrically operated oil furnace
- Laundry
  - Clothes dryer
  - Iron
  - Ironer
  - Pants presser
  - Tie presser
  - Washing machine
- Lighting
  - General purpose
  - Ornamental

The Electrified Kitchen

Other Home Services

Battery charger
Bell-ringing transformer
Bells, gongs, and horns
Bread mixer
Cake mixer
Cigar and cigarette lighter
Clock
Coffee grinder
Corn popper
Cream whipper
Curling iron
Egg beater
Electric fan
Electric screen door
Fan (or radiators of heating system speeds up heating or cooling)
Fire alarm
Floor sanding
Floor scrubbing
Floor waxing and polishing
Fly control by fans
Grinder and sharpener
Hair drier
Hair curler
Heating pad
Household motor
Ice cream freezer
Kitchen aid
Kitchen ventilation
Meat grinder, household
Mechanical toys
Milk warmer
Motion picture machine
Phonograph
Potato peeler
Radiant heater
Radio
Sausage grinder
Sewing machine
Shaving mug heater
Sump pump
Temperature regulation
Vegetable steamer

II Farm Uses

These uses provide for increasing income, for improving quality or quantity of products, for improvement in public health, and for relieving drudgery and making farming more attractive as a mode of life.)

Dairy

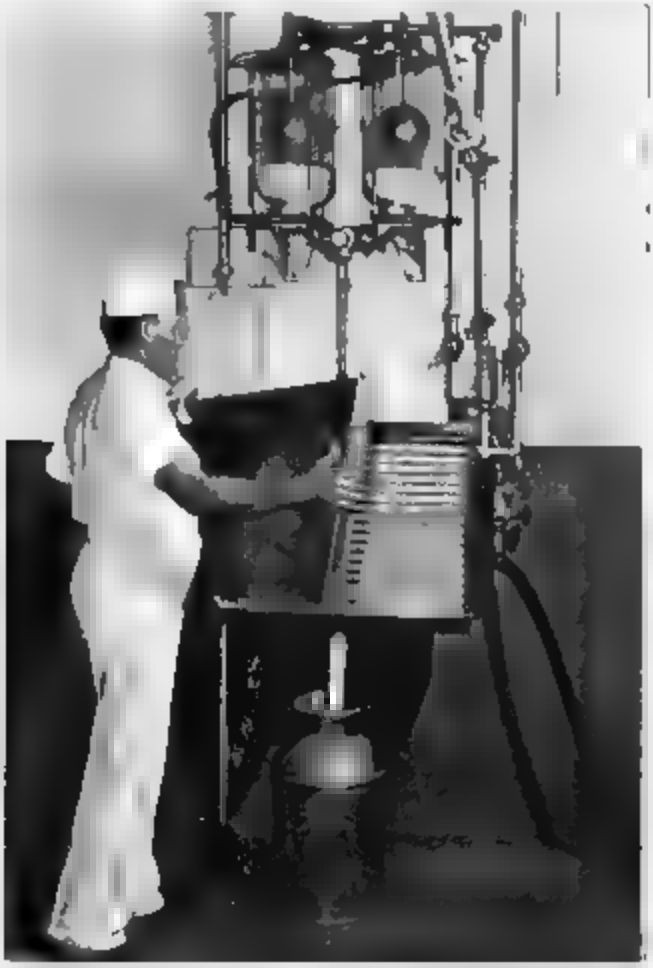
Uses on the dairy farm will frequently include a large number of those listed for the general farm, as well as the items below:

Barn ventilation
Bottle capper
Bottle washer
Butter making
Buttermilk maker
Churn
Capper
Cottage cheese machine
Cream ripener
Cream separator
Elevators for feed, grain, bedding
Ensilage cutter
Ensilage elevator
Fans for fly control in the barn and milk house
Feed grinder
Feed mixer
Fly traps and screens
Forage grinder
Groomer
Ice cream freezer
Ice crusher
Lights for barn, milk house, silo
Liquid manure pump
Manure drier
Milk bottler
Milk carrier or conveyor
Milk and cream tester
Milk cooling
Milk pump
Milk stirrer
Milking machine
Pasteurizer
  Electric
  Hot water
  Motor driven
Refrigeration
Stable cleaner
Sterilizer
Water heater
Water system

Fruit and Truck Farming

Apple-butter maker
Apple grader
Bulb sterilizer
Cider mill
Dehydrators for apples, berries, hops, nuts, prunes, raisins, rice and vegetables.
Electric garden tractor
Electric heat for plants
  Hotbed heating
  Propagating and cutting-bench heating.
  Frost protection
  Outside soil heating
  Asparagus, cucumber, gladioli, spring bulb, rhubarb, lettuce and other plant forcing

Fruit and vegetable colouring and ripening equipment
Fruit pulping for jam
Gooseberry grader and cleaner
Graders for bulbs, potatoes
Greenhouse heating
Insect traps
Irrigation pumps
Potato washing
Refrigeration
  Precooling
  Storage
  Freezing
Stationary sprayer
Strawflower drying
Vegetable washer
Vegetable grader
Walnut cleaner and polisher
Washers for roots, fruit (apples and pears)
Water system



Milk Aerator

General

Air compressor
Animal clipper
Automobile radiator or block heater
Bee house warming
Concrete mixer
Corn drying
Corn husking and shredding
Corn fodder shredding
Corn shelling
Corn and seed testing or germination

Drainage pumps
Drying:
  Ear corn
  Grain
  Hay
Electric fence
Electric plow
Elevator for grain and feed
Fanning mill for grain and seed cleaning
Feed grinder
Fertilizer grinder
Fertilizer mixer
Forage grinder
Grain grinder
Groomer
Hay baler
Hay hoist
Honey extractor
Hop baler
Lamb brooder
Lawn mower
Oat huller
Paint sprayer
Pig brooder
Portable motors
Sand hoist
Saw mill
Seed scarifier
Sheep shears
Shop equipment
  Band saw
  Buffer
  Drill portable, stationary, or combination
  Forge blower
  Glue pot
  Grinder
  Lathe
  Power saw
  Soldering iron
Smut treatment
Stump burner (forced draft)
Thresher

Poultry

Alarms
  Burglar
  Fire
  High and low temperatures
  No voltage
Automatic time switches
Baby chick nursery heating
Baby chick nursery ventilation
Bone grinding
Brooders
  Battery
  Canopy
Chicken feeders
Disinfectant sprayer
Egg candler
Egg cleaner
Green feed cutter
Incubators
Incubator ventilation
Lights for feed room, control of growth, egg production, prevention of cannibalism
Oat sprouter
Poultry house ventilation
Refrigeration for meat storage, egg storage
Root cutting and shredding
Scalding
Shell grinding
Straw cutting
Water system
Water warmer

III. Community Uses and Industries

Services

Churches
Garages
Gasoline service stations
Halls and other community centres
Recreation halls
Schools
Stores
Town halls and other public buildings

Processing and Other Industries

Butter factory
Broiler plant
Cannery
Cheese factory
Concrete block plant
Creamery
Egg cleaning and processing
Egg cold storage
Fish hatchery
Fruit drying
Fruit and vegetable colouring and ripening
Fruit and vegetable packing plants
Fruit and vegetable precooling
Grain elevator
Grist mills
Horseradish grinding
Milk condenser
Mustard grinding
Nurseries
Pea viners
Sand and gravel plants
Saw mills
Seed cleaning plants

An examination of the foregoing list cannot fail to impress one with the ramifications of the use of electric power. When it is considered that most of the uses enumerated were developed within the memory of men

still living, the enormously important role which electricity is playing in modern agriculture becomes self-evident. Coupled with the increased number of uses for electricity on the farm has been the expansion in the number of farms using power. This lends additional proof to the statement that electricity is coming to play an ever more important role in farm life.

Electricity and Increased Farm Income

The results of scientific experiment and practical experience are sufficiently clear to enable us to say that, in general, electric power on the farm tends to raise income. Whether electricity will increase income in the case of individual farmers, or of particular areas, it is impossible to say; conditions vary, and individuals respond differently to the same stimuli.

The contribution of electric power to increased income has been particularly marked in the case of poultry, hog and dairy production. Series of studies have been made showing the decreased mortality among chicks

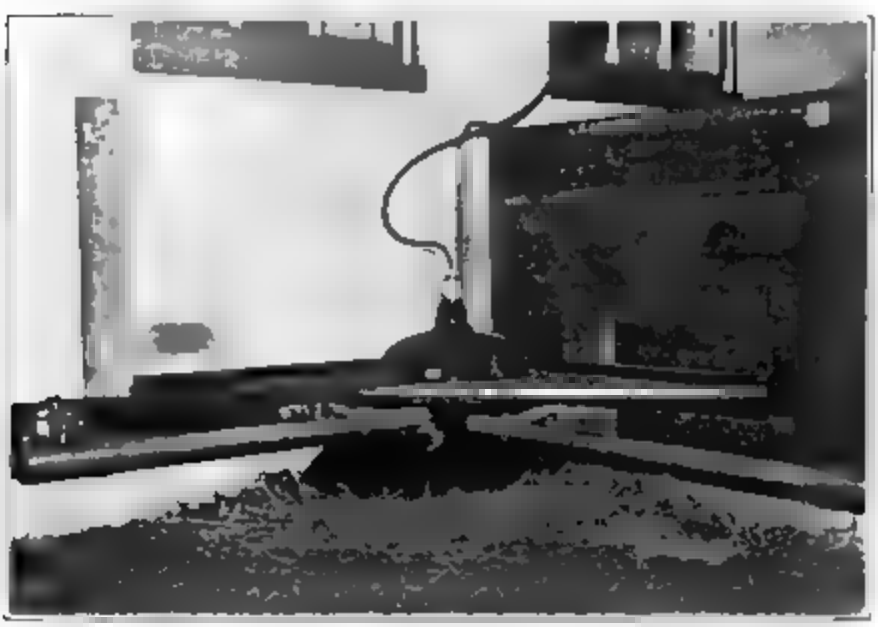
Electric Chicken Brooder

when a simple homemade chicken brooder (warmer) is used. A single electric light installed in a fairly airtight coop will reduce deaths from wet and cold. The increase in production will depend, of course, on the farmer, on the

season, and on the climate, however, under average conditions in the spring of the year, a decrease in mortality among young chicks of 15% is almost universal

Likewise the use of a pig brooder generally reduces to zero losses from wet and exposure[7] Losses from crushing are likewise reduced A chicken or pig brooder of satisfactory performance can be constructed for a sum varying from $3 to $5 Frequently all the materials needed except the light cord, socket and bulb are already available about the farm Mr L L Siemens of Altona, Manitoba, in a letter to the Manitoba Power Commission stated

> Last January I had ten sows coming in with their litters I have had winter litters for the last dozen years and always had trouble because of the cold, losses were huge Last winter I used an electric brooder lamp and I cannot speak too highly of its efficiency I could direct the rays onto the sow in the pen the bedding was dry and warm and I saved practically all my young pigs When I figure the amount in actual dollars saved, it would pay for the whole outlay of installation



Electric Hog Brooder

Some studies seem to demonstrate that a chicken will produce only a given number of eggs in its lifetime The farmer is interested in securing this number of eggs from the chicken in the shortest possible time, after which the bird may be sold for meat Furthermore, it has been demonstrated repeatedly that in order to facilitate steady and rapid egg-laying, the chicken must be kept active about 13 to 16 hours of the day In Manitoba, with the short daylight stretch in winter, egg production falls off by 50 to 90%

[7]Rural Electrification News, Nov., 1937, p. 19

on many farms. As a consequence the price of eggs rises frequently by 50% from May or June to February, precisely when the farmer has few to sell.

If the chicken house is insulated and is kept lighted with one or two electric lights, winter egg production can be maintained at, or virtually at, the spring or summer level. Production is increased by 20 to 50% depending upon circumstances. One recent study showed that under proper lighting conditions each hen produced an additional net return of 53 cents per year over and above the cost of the additional food intake due to the greater number of hours of activity.

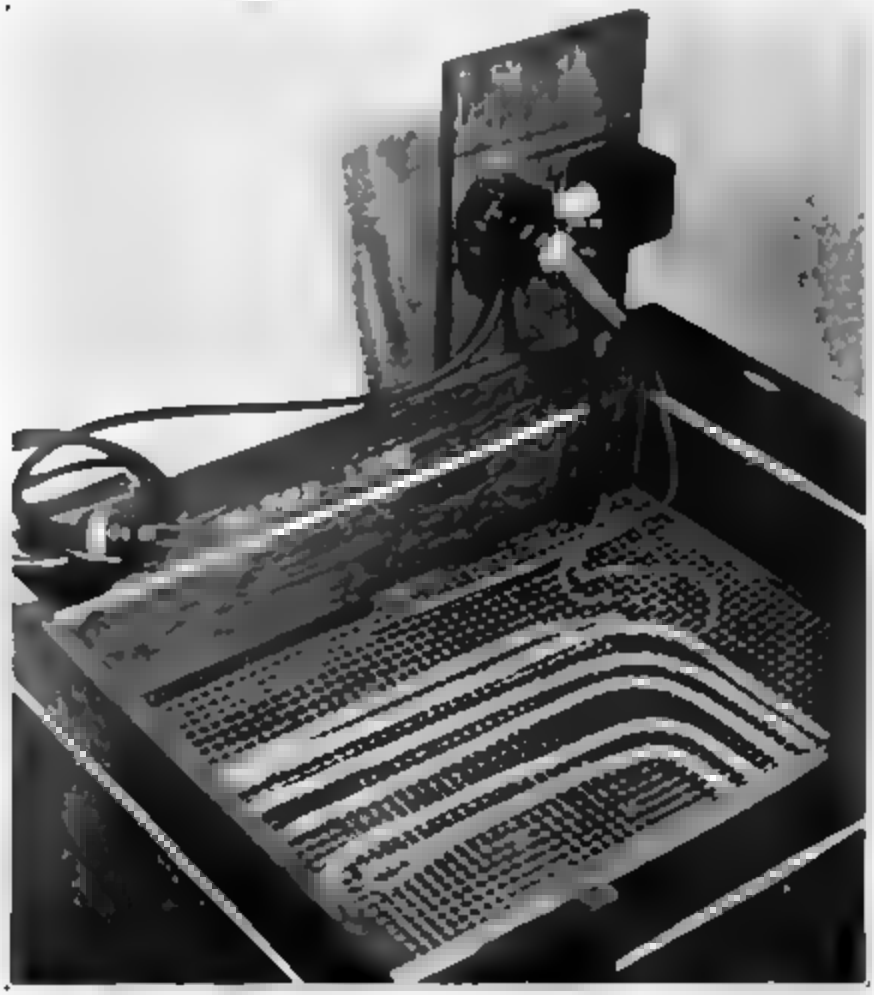
Since 65% of the content of an egg is water, the chickens, if they are to reach maximum production, must be induced to maintain their water intake. They will do this only if a plentiful supply of water at the proper temperature, not less than 50°F., is always on hand. Numerous scientific tests show that the average chicken will produce from 15 to 40 cents more in eggs per year from this one source alone. Thus a farmer with 200 chickens will secure an additional yield in eggs in a year ranging from $30 to $80, enough in many cases to pay for the electric power for this and all other uses upon the farm.

Thus by lighting the chicken house, pumping an adequate supply of water into the chicken house or yard, and by keeping the water at a temperature which will stimulate a maximum intake, the output of eggs may be increased by 50% or more.

The reader may raise the objection that if the farmers of Manitoba turn to scientific egg production, the market will be flooded and the price of eggs will collapse. This is a possibility but there are several other considerations. The adoption of more efficient methods of egg production may not necessarily increase the output, but rather reduce the cost of producing the present volume, and cost reductions are in the farmers' interest. Furthermore, not all farmers will automatically shift into large-scale egg production once they have electric power. Finally, diet experts, governmental agencies, and research organizations are united in agreeing that a vast portion of the population is not consuming sufficient eggs. Vigorous efforts are being made to expand consumption. What has been said of eggs also applies to dairy products, vegetables, and fruits, so that overproduction in these lines is less likely in the near future than would have been the case several decades ago.

Other studies have demonstrated the great importance of water in the production of dairy products, and beef cattle. Milk is about 87% water, a beefsteak contains a high proportion of water. If the livestock is not supplied continuously with an adequate flow of water, the intake will be reduced and, accordingly, growth and milk production will be retarded. Studies show that when the temperature of water drops below 50°F. cattle reduce their liquid consumption. The electric pump, either automatic or governed with a simple switch, provides assurance that an adequate supply of water will be available.

A simple electric stock tank heater which can be constructed for about $15 will keep the water above 40°F operating in a cold climate on about 4 kwhr per animal per day.



By the Stock Tank Heater

Other studies[1] show that fodder may be ground too coarsely or too finely. Proper grinding is essential if the animal is to recover the maximum amount of nutriment from the grains. A simple grain grinder with adjustable plates operated with electric power will enable the farmer to adapt the feed to his livestock for purposes of maximum production. In Sweden and Switzerland

[1] Available from most universities in Canada and the United States which specialize in agriculture, economics and animal husbandry.

farmers have developed animal-feed cooking and heating to such an extent that many electric utilities experience a consumption peak near midnight greater than the day-time peak.[9]

Several years ago a group of English farmers were asked to comment informally on the use of electric energy on their farms. Most of them reported[10] that while power did not reduce the amount of employed help, the farm as a unit got more work done, with an increase in output and an improvement in quality. A large proportion of them reported that public complaints about unclean milk decreased notably because of better stable lighting. Health and cleanliness of the cattle improved. Many of them reported that the adequate supply of hot water enabled them to scald the milk pails and appliances so that it was easier to keep the milk from souring and to meet public sanitation standards. A number had increased the amount of land under tillage. One farmer found that electricity cut out an hour of work in the morning and another half-hour in the evening. One farmer with 159 acres who turned his milk into cheese found that the better control of heat in the cheese room improved the quality of his product and enabled him to get a better price.

Reducing Costs

From the foregoing it should be clear that, properly utilized, electric power may increase the dollar yield from the farm. Will it also reduce operating costs?

Again, the answer to this question will depend upon circumstances. A fully electrified farm will entail an investment for wiring and appliances ranging upward from $500 plus some operating costs. The growth of rural electrification in the last two decades, however, is the best evidence that it has been regarded as practical by the farmers themselves.

Some suggestion of the costs and savings involved in the use of electricity may be gathered from the following tabulation.[11]

Use or Appliance	Cost at 5c per kilowatt hour[12]
Brooding	3c per 8 weeks per chick
Churning	4c per 100 lb. of butter
Corn husking and shredding	20c per ton
Corn shelling (1 to 5 hp)	4c per 15 bus.
Cream separating	3c per 1 200 lb. of milk
Farm-chore motors (3, 5, 7½ hp)	15, 25, 41c per hour of operation
Feed grinding (3, 5, 7½ hp)	6c per 100 lb.
Fractional-horsepower motors	2c per hour of operation
Grain cleaning	7c per 100 bus.

[9]Because this use of electric power was confined, through an automatic control device, to night-time, when the generating station had a low load, special low rates were made available. But the rates were so low that they created a new problem of night peaks. See E. P. Schmidt, *Public Utility Economics*, 1940, Chapter XII.

[10]Third World Power Conference, p. 620-22.

[11]Data from Canadian General Electric Company. Figures published by the R. E. A. are substantially similar.

[12]For a clear explanation of what a kilowatt hour (kwhr.) is, see Appendix to this chapter.

Use or Appliance	Cost at 5c per kilowatt hour[12]
Grain elevating 5 hp	15c per 1,000 bus.
Hay baling (5 hp	15c per ton
Hay hoisting (5 hp.	7c per 10 tons
Incubating (small)	$10 per 1,000 eggs hatched
Lighting entire farm	5c per day
Milk cooling	5c per 10 gals.
Milking (portable type	8c per cow per month
Sheep shearing	8c per 100 sheep
Silo filling	7c per ton
Soil heating (hotbeds	5c per day per 3' x 6' sash
Threshing (10 hp)	2c per 100 lb. of grain
Water supply all farm uses	$1 25 per month
Wood sawing 5 to 7 ½ hp	5c per cord

Hoisting Hay Electrically

A Manitoba farmer informed the Commission that before he had electric power he, or someone in his household, had to pump water for a half day each day in the summer months. "Now" he said, "5 cents worth of electricity does the job."

If the farmer must haul his grain to the local mill for grinding purposes, expenses are incurred for sacks, sacking, and hauling. During bad weather the roads may become impassable and his livestock feeding operations may

[12]For a clear explanation of what a kilowatt hour (kwhr) is, see Appendix to this chapter

suffer Several farmers in Ontario operating 100-acre farms informed the Commission that the net savings in dollars from doing their own grain grinding were sufficient to pay for their entire electric bill

Fresh Running Water Available at All Times, Thanks to Electric Pump

Similarly little imagination is needed to suggest that electric power on the farm may reduce numerous other operating costs About 14,000 Manitoba farmers according to the 1931 census, use 17,000 gasoline engines on their farms Not only is the gasoline engine much less flexible and adaptable to numerous farm operations because of its weight and non portability but from an operating standpoint it is more expensive than an electric motor assuming usual electricity rates and gasoline costs at 25c a gallon

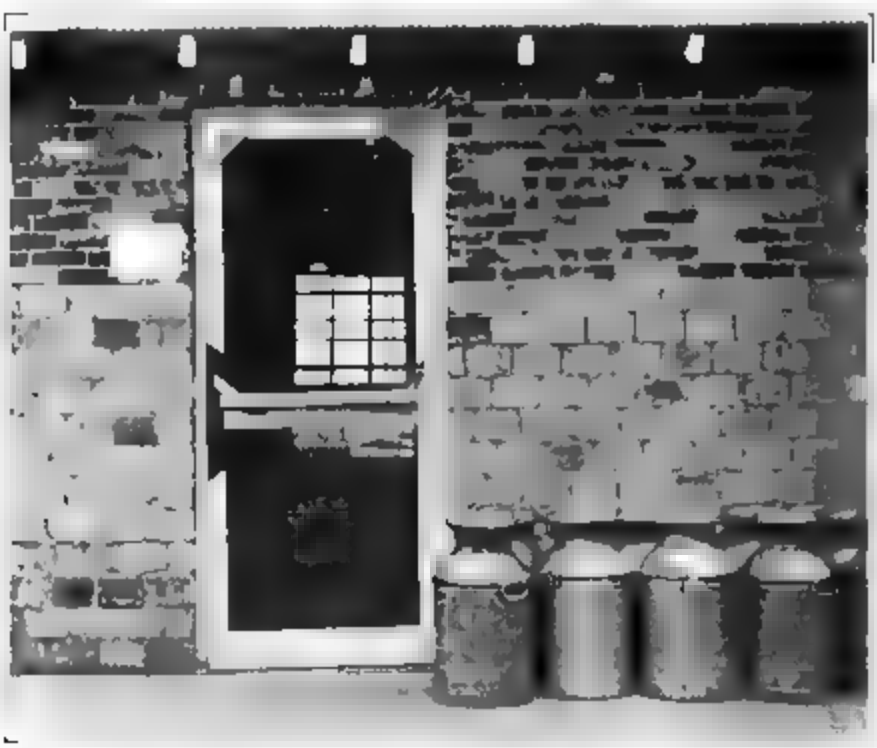
In numerous other respects electricity on the farm may reduce operating costs One such reduction is that in fire losses Mr W J Parker president of Manitoba Pool Elevators Ltd in his appearance before the Commission referred to several cases where a kerosene chicken brooder caused the destruction of the chicken house and the chickens as well In one case in the spring of 1942, this destruction also included the residence of the farmer and the life of one of his sons When electricity replaces the lamps and lanterns of more traditional times, reduction in fire losses naturally ensues, which tends in time to reduce insurance rates Furthermore if the farm has a large dugout and water under pressure the danger of destruction of buildings from fire

is materially reduced. Without a power pump a farmer has practically no protection once a fire breaks out.

From the foregoing it is clear that electricity on the farm may improve the net earning power of the farm by more effective utilization of the factors of production and by the elimination of some costs which are otherwise inescapable.

Does Electric Power Encourage Diversification?

That this Commission believes the answer to the above question is in the affirmative the reader will have gathered from previous discussions. Here again a warning is necessary. Electricity alone cannot solve basic agricultural disabilities. However if other conditions such as climate, geography, freight rates, and market conditions are reasonably propitious, electric power may constitute that extra stimulus which will encourage greater and more rapid diversification. Nearly every student of agricultural problems who has looked into the role of electricity in a diversified agriculture has come forward with an optimistic viewpoint.



Electric Screen Door Protects Milk and Dairy Products from Flies, etc.

The Commission in its numerous discussions with farmers, farm leaders, and the public officials of the R.E.A. in the United States repeatedly raised the above question. The consensus of opinion was that in areas of monoculture where no tendency toward diversification was visible, electric power on the farm will not stimulate much diversification, in those areas reasonably well adapted to a multiple-crop system and the production of livestock and dairy products electric power will hasten diversification. Recognizing that Manitoba agriculture has been becoming steadily more diversified the Commission is inclined to take the view that electric power will encourage this wholesome movement.

The uses of electric power on the farm are so numerous that it would indeed be surprising if a substantial number of farmers were not stimulated to enter new lines of production. The gains from egg production have already been discussed. The modern requirements of dairy farming—healthful cattle, milk cooling, scalding of pails, cans, and cream separators—make electric energy for power, heating, and lighting almost indispensable. The dairy farm normally must have power for water pumping, at present less than one-fourth of Manitoba farmers have any gasoline engine power for this purpose. A power extractor is necessary for production of honey on a large scale. The production of vegetables is greatly facilitated through soil heating for the early germination of seed (though this use may have limited scope in Manitoba because of the late spring). No less an authority than H. A. Morgan, director of the Tennessee Valley Authority, states, 'In farm operations, electricity makes for greater diversified production. Increased financial returns are possible. Overspecialization may be combatted and a better adjustment to markets achieved."[13] In Sweden many farmers partially refine their crops in the barn, "a circumstance worthy of special mention because rural electrification has been particularly helpful in the treatment of crops in the barn."[14]

Will Electric Power Make Farmers More Self Reliant?

One partial solution to the low cash income of farm people throughout the West is the production of greater output for consumption on the farm. Electric power, we have already seen, should encourage the diversification of farm output, from this will flow almost automatically a greater volume of goods for farm consumption. H. A. Morgan of the T.V.A. states, "Electric-powered farm processing gives the farmer additional stabilizing self-containment. The self-contained farm depends upon a diversified output."

The best modern thought in regard to healthful living points to the great importance of a diversified diet. The "fortifying" or "protective" foods such as eggs, dairy products, fruits, and vegetables should be consumed

[13]Third World Power Conference, p. 790.
[14]Ibid., p. 687.

in larger quantities and many of them in their natural state. Here the farm, on which many or most of these products are grown, can make a greater contribution to the health and strength of the nation.

Inexpensive electric dehydrators have been developed for farm use. Dried products not only can be preserved for long periods of time but require less storage space. When desired for consumption, most of the products can be restored to their normal shape and size by a simple hydration process.

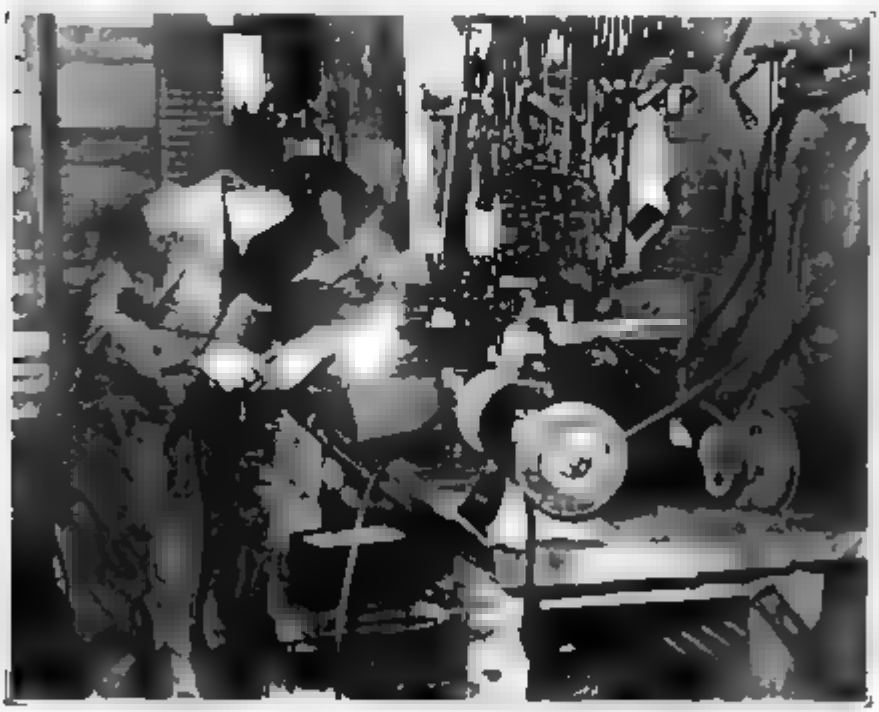
Home-made Dehydrator

By providing cold storage facilities electric power will also encourage the killing of livestock on the farm, and the storage of the product over several seasons.

In the early years of the nation the output of each farm was well balanced for the sustenance of its owner and its workers. The farming system was diversified. Here was self-containment in an elementary form. The development of industry brought fundamental changes. For certain farm-raised commodities industry and commerce offered prices that were attractive to the farmer, and the farmer in turn found that he could conveniently buy industry-processed food, clothing and other articles. Self-contained diversified

farms began to pass, specialized cash-crop farms taking their place in large sections of the country. An economy of climate—the geographical fact that a certain crop grows better in one part of the country than in another—also influenced specialization.

This division of agricultural function and labour was held to be simply an expression of the modern trend. But that does not mean that it was good for agriculture or for the nation. Specialization certainly took from agriculture a measure of that stability which enabled it to serve—as well as a depression buffer. There are those who decry a return to diversification and self-contain-ment as "subsistence farming," tainted with the inferior past and not in keeping with modern standards. Let them recall that this very self-contained farming of half a century to a century ago permitted in many farming communities of eastern Canada high standards of living and substantial homes that have not been equalled since.



The Farm Workshop

It is not necessary to return to the days of the spinning wheel to put the farm family back into a position that will enhance the national welfare. Farmers will neither have to lose the good things of the modern age nor retrograde to a lower standard of living. On the contrary, it should be possible

to preserve all that has been gained and to diffuse these gains much more widely This should come about through the introduction of a measure of modern self-containment into the lives of the present farm people, and later into the living of those who find it desirable to make a rural adjustment with urban habits of life There is need of a companionship of agriculture and industry that will benefit both

Electric Power and Growth of Villages and Towns

The extreme dependence of the Winnipeg area on the prosperity of Manitoba and western agriculture has already been stressed Winnipeg needs greater vitality and opportunities for growth the best way to achieve this end, the Commission believes, is by means of a growing and prosperous tributary territory Urban and rural prosperity must go hand in hand, more so in Manitoba than in most settled areas of the world

If the conclusions drawn in the preceding sections of this chapter are sound and electric power is brought to a substantial number of farmers, we can expect greater prosperity not only in Winnipeg but also in scores of small hamlets, villages, and towns.[15] This growth in turn will help further to sustain a prosperous agriculture by providing a market for eggs, dairy products, vegetables, and other produce.

Contrary to a widely held popular belief cheap power is no easy step to industrialization, it is no guarantee that industry will be lured thereby However the mind of man is ever active Here and there someone is always trying something new Many of these trials end in failure Some small few succeed With an expansion of power to several hundred more hamlets and villages not now supplied with power, or supplied with unreliable power, it may be reasonably anticipated that some growth will occur A modern example of a thriving community is Steinbach in the southeastern section of the Red River valley Here is a town without even a railroad, boasting several small manufacturing plants in a thriving condition The municipality (Hanover) in which this village is located increased in population by over 40% from 1931 to 1941 Farm land is said to be worth $100 an acre. This is a splendid example of the interdependence of farm and town As H A Morgan of the T V A has said, "Rural electricity and rural processing industries within the interior will support each other"

Unquestionably there are forces in operation contributing to the decline of small urban communities This trend is generally looked upon as unwhole-

[15]The critic may urge that if the farm becomes more diversified and the farmer raises and processes more of his foods for consumption on the farm, this would injure Winnipeg and other urban areas This argument overlooks the fact that prosperity on farm and in town must go hand in hand A growing industrialized China, for example, automatically becomes a better customer for American goods This is a matter of common knowledge among students of trade A prosperous agriculture will benefit the economy of the entire province

some That electric power on the nearby farms and in the hamlets and villages can stop this trend is too much to expect That it can slow down the trend may be a possibility in some instances it may reverse the trend perhaps this is all that can be expected This question has been widely discussed by students of rural and small town electrification In general they are mildly optimistic that some beneficial results will flow from the broader extension of electric power J M Kennedy chief technical commissioner of the Electricity Commission of London, England states In Great Britain we find that there are quite a number of small industries which either already exist in rural communities or which spring up as soon as electricity is made available at reasonable prices [6]

R Pesaud of the French Ministry of Agriculture made such an illuminating statement on this problem that we quote it in full

> Among the possibilities offered by rural electrification there is one which may have an important influence on country life in France, viz the decentralization of certain industries. This fact is all the more interesting in that it may restore a very old state of affairs in certain regions where hand work was formerly an important element of prosperity Machines could not be used because there were no motors, either in the village or in the home.
>
> The electric motor is restoring the possibilities that existed in former times, and such industries capable of decentralization have already experienced this fact Not only do we see today small workshops which may group from ten to twenty workmen installed in certain villages but we also find a vast region electric motors operating on the farms either for actual working spare time in the winter or for keeping surplus members of the family busy and thus by modern means we come back to the trades which were those of our ancestors There is one remarkable fact about these rural industries and that is that when they reappear after long years of interruption in particularly in those places where they had existed before Electrically driven wood working machines are to be found on the farms in the Landes and the St Etienne regions where they used to be in the olden times The home industry of the cutting of precious stones has come back in the Gex on the Swiss border The manufacture of toys brushes and buttons is being developed in the Beauvais, wood turning in the Jura the Vosges, and the Savoy, more particularly for the manufacture of pipes, tool handles, window sheets etc In other places, however, there is a tendency to organize new industries in this decentralized form
>
> It is thus that the rural population has at hand a means of supplementing their family resources which are so dear to the French farmer and the head of the family has been able to keep at home those children who, had it not been for a local means of remuneration, would have been forced to go into the towns
>
> For all these home industries, generally speaking, a motor consuming from 1 to 2 hp is sufficient, as it is also used for the light work on the farm.[7]

That rural electrification may help revive or create rural industry is attested to by evidence not only from Europe but also from the United States The R E A has brought power to hundreds of thousands of farmers since 1935 A survey made late in 1941 showed that a total of 2 965 rural industrial and commercial establishments were taking services from R E A systems New connections were being made almost daily [8]

[6] Third World Power Conference, p. 800
[7] Third World Power Conference, p. 800.
[8] R E A., Annual Report, 1941, p. 8

The R.E.A. is also authority for the following statement

> Industry is rising in rural America. Shops are springing up in many places along the lines by which electricity is reaching the farms. As a post-war prospect this industrialization has unmistakable significance. Industry is going back to the land. The plant on the country roadside today was smaller yesterday. The owner will tell you of prospects for greater growth tomorrow. Right now he is immersed in turning out war orders or in converting his plant to war production. But he will tell you that he has no intentions of suspending operations when the war ends. His mind is set on permanent industry.[19]

In Indiana, three miles west of Monroeville, there is a little shop that manufacturers wooden beverage cases and wooden poultry crates. In Ohio, on the highway south of Pasco, a man and his wife are running a knitting business with four knitting machines, supplying goods to a large firm in Chicago. In Minnesota, again in farm country, there is a tiny shop equipped with a wood lathe, a circular saw, and a grinder turning out yokes and veneers. In South Carolina, Georgia and Florida there are rural box factories, furniture factories, foundries, as well as sugar mills, turpentine stills and lumber mills. South Carolina, in addition, has a clay processing plant, a paprika plant, an ice-cream factory, and a commercial fertilizer factory. Rural Georgia also has a peanut-shelling factory as well as many local textile shops.

It is hoped that a similar development can be expected to flow from electrification in Manitoba. It is worth while to point out that this province has received a great number of European immigrants, who before their departure from the old country were skilled craftsmen in many lines of endeavour. This skill and training has lain dormant in most instances but some of the schools, the Searle Grain Company,[20] and many individuals such as Robert England[21] have made efforts to bring about conditions under which this skill could once more be put to use.

Part-Time Farming

Another possibility which may flow from the expansion in the use of electric power on the farm and in the small hamlet is the development of part-time farming. The R.E.A. reports numerous cases where a farmer, handy with tools, has developed a small production of nonfarm products. Thus in his spare time one farmer is producing venetian blinds for which he has developed a steady local market. Others are producing egg crates and other containers.

In Massachusetts this companionship of agriculture and industry is taking the form of part time farming. In many cases the family is sustained

[19] Rural Electrification News, July, 1942, p. 8. It is quite probable that after the war of the 1940's the Dominion government will favour and foster the decentralisation of industry as a national defense policy.

[20] The Searle Grain Company has organized scores of classes of women to teach them the ancient art of weaving. See the Searle Grain Company Bulletin, Aug. 8, 1942, p. 1.

[21] *The Colonization of Western Canada*, 1936.

chiefly through industrial employment, but farming is the mode of life. Family income is augmented and good health maintained by an abundance of fresh milk and garden vegetables. Sometimes specialized or extensive farming is carried on. In a recent study David Rozman estimates that about half the farms of Massachusetts are part time farms and that at least one-third of the agricultural production of the state comes from such farms. He writes:

> Of the various influences exercised by part time farming, probably the most outstanding is its effect on the character, health, and morale of operators and their families. According to the greater testimony of operators, the outdoor work has proved to be of great benefit to them all. Most of the operators worked during the day in closed buildings and while many of them performed only light tasks, they found themselves tired at the end of the day often from the mere monotony of work around machinery. The housing in part time farming free from the overcrowded and unsanitary conditions of city tenements, proved also to be an important factor in creating a more healthful environment.[39]

If overspecialization was a step backward, the electrified farms of Massachusetts have already begun to take a step forward.

The mere statement of the problems of agriculture shows a lack of balance between agriculture and industry. It is essential to agriculture and equally important to commerce and industry that a balance be established. Such a balance constitutes the basis of a stable society. The concentration of urban industry was to a great extent the result of such industrial concentrating forces as steam power, rail, and waterway transportation, combined with the necessity for people to live near the factories in which they worked. Today the automobile has made the worker more mobile, the modern highway has brought good freight transportation to every locality, and electrical transmission of power can be made to serve economically the great agricultural interior and change it from a source of raw products to an area where industry and agriculture may develop close and mutually beneficial companionship. Along the Atlantic seaboard in the United States and in the Great Lakes shore areas in Canada, small industries widely distributed in the rural towns have been able to share much of the cost of distribution of electric power.[23] All these various rural uses for electricity other than on farms have an important bearing on rural electrification. Every additional use and user make the extension of rural lines that much more feasible. Some of these uses will be mentioned below.

In the United States the co-operative group refrigerator and community cold storage or frozen storage plant, with rentable lockers, render a desirable farm service for promoting health, increasing income and fostering better farming practices.

Large fruit, nut, and hop dehydrators are excellent examples of crop-processing industries of the Pacific coast. The preservation of fruits by freezing

[39] Quoted in Third World Power Conference.
[23] Third World Power Conference, p. 786.

and the making of syrups and sorghum are examples from other sections. Thomas Sanderson of Portage la Prairie states, "Along with our farming operations we operate a grain cleaning plant. We contract quite large acreage of peas and these we prepare, grade, etc., for market. We estimate that we will handle through this plant at least 25 car loads besides considerable other grains." Another farmer near Portage la Prairie, the operator of a peony farm, writes:

> We grow annually about 60,000 pounds of garden seed for the seed department of a large retail store, comprising three varieties of garden peas, three varieties of garden beans, soy beans, sweet corn, gladioli bulbs and peony roots, in all of which we use electric power and light in handling. The peas, beans, and corn all have to go through a cleaner driven by a half horsepower motor. After that the seed goes over a hand picker driven by a quarter horsepower motor with electric light and reflector over picking table. . . . In drying gladioli bulbs and sweet corn we use a quarter horsepower motor attached to a large fan.

The line between processing on the individual farm and carrying on the operation as a community industrial project, often on a part-time basis, is not sharply drawn. Sometimes it may be most practicable for such operations as drying, freezing and dehydrating fruits and vegetables, grinding and mixing feeds, mixing fertilizers, cleaning seeds, and extracting oil to be carried on co-operatively by a number of farmers. Under other conditions individual farm operations may be preferable.

Some of these processes offer possibilities for development into small industries giving whole or part time employment to those who live and work on self-contained farms. Woodworking plants operated by electric power utilize a product of the land and are well suited to small unit development. Important industries of certain types find greater stability in rural territory. For example, certain branches of the textile industry operate satisfactorily in small units and some of these plants have retained advantages of mass production by modern methods, providing also self-containment for workers living on their own small tracts or farms.

An outstanding example of the companionship of agriculture and industry in the small city is found in Kingsport, Tennessee. In a relatively short period more than a dozen different industrial plants became established there. Most of the employees live in the country, some ten or more miles from the city. The stability of this type of self-containment was apparent at Kingsport during the worst years of the depression.

Removing Drudgery from Farm Work

Farm women are usually as enthusiastic about electrification as the men. Indeed in some areas the women take the lead in the movement. In the United States one or more women are usually found on the boards of directors of the 900 local electric co-operatives.

The unfortunate lot of the farm wife has been pumping water, carrying heavy pails of water from pump to house, keeping the not-too-bright kerosene

lamps in trim, turning the wash machine and wringer, standing over a hot iron heated on a hot stove, and many other needlessly burdensome duties. In this connection a German authority states, "Working periods of sixteen to eighteen hours daily are by no means rare. In consequence there is an alarming exodus of the younger generation to the city, affording easier means of existence. Any saving or easing of work in the rural household must, therefore, be highly appreciated and valued from an individual and social point of view."[24]

Were no other inexpensive method of doing these tasks available, the farm woman would perform them without complaint so long as her strength

Electric Vacuum Cleaner

[24]Heinrich V. Waechter. Third World Power Conference, p. 577

endures But she knows that other cheap methods are available At 5 cents per kwhr the energy cost for pumping domestic water will be much less than a cent per day or perhaps $2 per year The washing machine can be operated for a year for a dollar's worth of electric energy The economical operation of other appliances is indicated in the following tabulation

Appliance	Cost at 5c per kwhr
Electric clock	8c per month
Fan	5c for each 10 hours operation
Iron	5c per person per month
Ironing machine	40c per month
Lighting and small household appliances	$1 25 per month
Radio All electric	40c per month
Battery chargers	25c per month
Range	5c per person per day
Refrigerator	5c per day
Sewing machine	5c per month
Vacuum cleaner	15c per year
Washing machine	10c per month
Water heater	25c per day
Water supply Shallow well	25c per month
Cistern	7c per month

Unless these tasks of our farm women are lightened, we must expect the drift away from the farm to continue The farm boys and girls know that the back-breaking jobs in the cities have been largely assumed by domestic conveniences and power tools. Unless some hope is held out to them that they also will benefit from these mechanical inventions we cannot expect them to stay on the farms Especially will it be true that the brighter boys and girls will migrate to the urban areas and the less competent and less enterprising will remain on the farm—but farming is a business and requires just as much intelligence and ingenuity as does urban industry

The installation of electric power has revolutionized life on farms. Celebrations in the United States in honour of the energizing of the farm power lines have dramatized this fact by ceremonies including the wholesale burial of kerosene lamps—as a symbol of drudgery being abolished by the installation of electricity Water-pumping plants making possible a modern bathroom and plenty of running water for the stock, kitchen, and laundry, electric lights for house, barns, and farmyard, electric refrigeration for both food and farm products, labour-saving electrical appliances for both home and farm—all of these contribute immeasurably to the enjoyment and comfort of rural life.

Vivid and touching are some of the statements of farm families testifying to this fact The housewife who formerly did her ironing over a hot range or unsatisfactory gasoline or kerosene stove can now, on a hot day, move her electric iron onto a shady porch and do her work in comfort Roy Mullin of Myrtle, Manitoba, in speaking of his power ironer said, "My wife can sit on a chair and do the week's ironing in a few hours" One farmer wrote "Thanks for the only good lights we ever had." One Minnesota farmer said to the Commission, "If you are devoted to your wife the first thing you will

The Electric Washer

do for her is to get her a power washer then get her an electric iron. If you have money left see that she has water pumped into the house.

In one section of South Carolina, where the farms are small and relatively nonproductive, it has been impossible thus far to extend the power system on a self-sustaining basis. The community church, however, is served by an R.E.A. line, and there the housewives gather every Tuesday for an ironing bee.

Mrs. G. Berri of Dufresne, Manitoba, states the case well. "I would like to mention the difference having hydro service on the farm has meant to us. We have an electric range, refrigerator, hot water heater, radio, washing machine, and we have on the farm all the advantages of town life. Our buildings are all wired. Previous to hydro service we had a gas motor on our pump and milking machine. Changing to electric motor, we had considerably cheaper and trouble-free operation."

Similar testimony, of the role of electric power on the farm, could be expanded without limit, but enough has been said to give the reader a picture of its possibilities.

Summary

While electric power on the farm is no cure-all for western agricultural problems, this Commission takes the view that it will to some extent have the following effects:

1. Improve income from farm products.
2. Reduce farm operating costs.
3. Encourage a greater variety of farm products which will more readily find a market.
4. Encourage the growth of more products for consumption upon the farm.
5. Make the farmers somewhat more depression-proof.
6. Encourage to some extent the development of nonfarm activities upon the farm.
7. Create a better market for urban-produced products.
8. Lend more stability to the small hamlets and villages throughout the province.
9. Remove the drudgery from the operations of the farm home and the farm itself.
10. Reduce the tendency of young people to abandon the farm as a method of making a living and as a way of life.

To what extent these objectives will be realized will depend upon the proportion of farms which are electrified, the price of electrical appliances, the cost of building wiring, and the cost of constructing the lines along the highways.[25] If the capital and operating costs are so high that most farmers will confine themselves to electric lights and few small appliances, then the real objective of rural electrification will not be achieved. To gain the foregoing advantages it will be necessary to achieve the complete electrification of the farm home and other buildings.

[25]Techniques for reducing these costs are discussed in Chapter X.

WHAT IS A KILOWATT HOUR?

When you buy electricity you buy "work." Work can be expressed in energy required to lift a weight against gravity. For example, if a person lifts 10 one-pound bricks per minute a distance of 1 foot, or 1 such brick through a distance of 10 feet, he would perform 600 "footpounds" of work in an hour.

If it were possible in some way or other to equip an individual with a small generator, it would be found that despite the most strenuous efforts he could not, with his own muscle power, produce 1 kilowatt hour (kwhr) of energy in a day. One kwhr of electricity equals the energy required to lift 2,655,200 pounds 1 foot against gravity. An engine delivering 1 horsepower does work equivalent to lifting 550 one-pound bricks 1 foot *every second*, or 33,000 one-pound bricks 1 foot every minute. Electrical power is measured in kilowatts, a kilowatt being equal to 1 34 horsepower, or 1 horsepower is about three-quarters of a kilowatt.

In an experiment in New York City a champion bicycle racer pedalled a stationary bicycle equipped with a small generator, yet after exerting himself to the utmost for a full minute, he was able to produce only .0018 kwhr. Even if he had pedalled at the same pace for 8 hours, he would have produced less than 1 kwhr. Obviously such strenuous effort could be maintained by no man for more than a minute or so. In another instance, 213 people rode this machine until they were tired and their combined work amounted to 2.5 kwhr. One kwhr is always more work than any man can do in a day.[1]

The following tabulation, derived from scientific experiments, indicates the amount of work (reduced to electrical units) which a man can do in certain specified periods.

COMPARISON OF MAN'S MUSCLE POWER WITH ELECTRICAL POWER[2]

		No. of Hours Men Can Keep It Up	Work Done (kwhr)*
1.	Shovelling 25 tons of loose dirt up 5 ft. 8 ins.	10	11
2.	Pushing wheelbarrow up 1/12 incline and returning unloaded (51 tons up 3 ft.)	10	12
3.	Carrying the hod upstairs and returning unloaded (16.7 tons up 12 ft.	6	15
4.	Hammering	8	17
5.	Lifting weights by hand (65 tons up 4 ft.	6	8
6.	Lifting with rope and pulley and lowering rope (21.5 tons up 15 ft.)	6	24
7.	Pumping 11,200 gal. of water up 10 ft.	10	45
8.	Turning crank or winch (25 tons up 25 ft.	8	48
9.	Pulling or pushing horizontally, as on oar	8	57

*By assuming 1 kwhr of electricity to be worth 5 cents, the reader can see what waste is involved in the use of hand power when electric power can do the work.

Thus, it may be seen that by pumping for 10 hours a man can do about half as much work as 1 kwhr of electrical energy. Lifting weights by hand, he can do about 1/5 of 1 kwhr in a day, in the case of hammering, about 1/6 of 1 kwhr can be done in a day.

Normally 1 kwhr of energy can be purchased in most parts of Canada for 5 cents or less. Incredible as it may seem, this one kwhr is equal to the muscle of a man pumping water for two working days, lifting weights for about five days, hammering for about six days, carrying the plaster hod for about seven days, wheeling bricks for about eight days, or shovelling for about nine days. As Dr. Steinmetz, the famous General Electric Corporation electrical wizard, said, "The electrical way is always the cheapest way."

[1] Edison Electric Institute Bulletin, June, 1930.
[2] Kent's Mechanical Engineer Pocketbook, 1916.

CHAPTER V

POSTWAR EMPLOYMENT AND FARM ELECTRIFICATION

Premier John Bracken, in the terms of reference creating this Commission, said "In order to meet, and if possible to avoid after the present war, the depression, unemployment, and distress such as followed the last Great War, the Government of Manitoba is planning now, policies aimed to provide employment. . . "

Is a Postwar Depression Inevitable?

Wars generally are followed by widespread unemployment. Extensive unemployment is so destructive to morale, skills, the plane of living, and social stability that it cannot be tolerated. Wage and salary workers probably suffer more from unemployment than any other groups. All, however, are its victims.

There is a striking parallel between industrial employment and farm product prices. When the industrial worker loses his source of income, he virtually eliminates expenditure on furniture, new housing, and appliances, including automobiles and many other durable goods. More unemployment follows, becoming cumulative. The worker next reduces his purchases of food, clothing, and many other products the raw materials for which come from the farm. These contractions cause a collapse of farm product prices, the farmer suffers a deterioration in his standard of living, and in turn restricts his purchase of city-made products to bare essentials. Thus the division of labour and the mutual co-operation between agriculture and industry under the private enterprise system break down. The downward spiral of deflation sets in, feeding on itself, with all the attendant miseries of mass unemployment.

Already people are saying "If the government can spend billions of dollars for prosecuting the war, there is no good reason why the government cannot spend equal sums to help maintain the standard of living in times of peace." Negative responses will not meet this challenge. The majority of Canadians may be convinced that the ideal is employment in private industry, but if the choice lies between starvation and government enterprise, the people will naturally choose government enterprise. The Government of Manitoba feels an obligation to be prepared to provide employment if the private enterprise system does not do the job.

Whether extensive unemployment will promptly follow the current war it is hazardous to predict. It is sometimes forgotten, however, that mass unemployment did not follow immediately after the last war. During a prolonged total war, the manufacture of most durable goods, such as housing, motor cars, furniture, household appliances, and many other commodities, is postponed. Equipment on hand wears out, becomes obsolete and inadequate.

Population grows and once the war is over an enormous "banked up demand" is released, creating a postwar boom and extensive employment opportunities. Responsible opinion in the United States inclines to the view that this war will be followed by a boom—a boom which may endure for about one year for each year of total war

However, the labour supply has been enormously expanded during this war. Many people who never worked for wages before, especially daughters and wives, have been drawn into the labour market, many may want to remain at work and will constitute part of the labour supply Furthermore, even if a boom occurs it is not probable that it will be as intense as war activity Thus it is conceivable that we may have unemployment in the midst of a postwar boom, preparation should be made now to meet this challenge. Above all, everything possible should be done to make certain that every member of the armed forces who returns to work will not have to compete with mass unemployment. Rather we should make certain that the demand for labour will be so brisk that the returned man will have little difficulty in getting a foothold in industry once more.

The Government of Manitoba is aware of the implications of the postwar re-employment problem as it relates both to members of the armed services and to war industries. The work of this Commission as a part of the postwar planning work is evidence of this awareness. The Government at Ottawa is also devoting substantial consideration to the problem.

Dominion Postwar Planning

At Ottawa shortly after the opening of the war a Cabinet Committee on Demobilization and Re-establishment began giving attention to problems of the re-absorption of men from the armed services into civilian life. In August, 1940, Parliament created the Advisory Committee on Demobilization and Rehabilitation which commenced holding hearings promptly One of the results of the work of this committee was the development of a comprehensive plan for the careful selection of members of the armed services for settlement upon farms after their demobilization and discharge Every effort has been made in the development of this plan to avoid the weaknesses of the Soldier Settlement Plan which followed the close of the war in 1918.

As the work of the committee progressed, "it became necessary to attempt to gather together the various developing ideas, proposals and projects relating to the postwar period, and the government therefore set up an advisory committee reporting to the Cabinet Committee on Demobilization and Re-establishment, known as the Committee on Reconstruction with the same terms of reference as the Cabinet Committee, namely to examine and discuss the general question of postwar reconstruction, and to make recommendations as to what government facilities should be established

to deal with this question.[1] Arrangements were made to have the chairman and the vice-chairman of the General Advisory Committee on Demobilization and Rehabilitation and also the chairman of the Canadian section of the Joint Economic Committees attend meetings of the Committee on Reconstruction and afford the fullest co-operation

The Committee on Reconstruction under the chairmanship of Dr F. Cyril James has been holding hearings and has now developed an elaborate agenda for enquiry Several subcommittees have been set up, each concerned with a specific problem These subcommittees include the following

1. Agricultural Policy Chairman, Mr D G McKenzie.
2. Postwar Employment Chairman, Mr Tom Moore
3. Conservation and Development of Natural Resources Chairman, Dr R. C. Wallace
4. Construction Projects Chairman, Mr K. M Cameron.

It may be of interest to note that the terms of reference of the latter committee read as follows

> To study the extent to which a carefully formulated programme of construction projects may contribute to the national welfare of the Dominion of Canada, as well as provide employment opportunities during the postwar period To report to the Committee on Reconstruction regarding the way in which such a programme may be most effectively organized in advance of the termination of hostilities.

This subcommittee has already made enquiries as to what categories of construction projects should be established

(a) Dominion projects only?
(b) Dominion and provincial projects?
(c) Projects involving municipal participation?
(d) Projects involving the participation of private enterprise?

Whether rural electrification as a postwar employment programme should be an exclusively provincial project or should fall in one or the other of the above four categories is a matter that can be determined only as the programme of the Reconstruction Committee develops and as the federal and provincial governments evolve the details of their joint and individual plans.

By creating the Manitoba Electrification Enquiry Commission the Government of Manitoba lent support to the view that one of the postwar employment projects should be a comprehensive programme of farm electrification within the province We have already seen that (1) farm electrification in many parts of the world has brought central station electricity to from 25 to over 90% of the farmers, and (2) power on the farm has become an indispensable tool both for making farming more remunerative and for improving farming as a way of life Furthermore, a sample study made by the Committee on Demobilization and Re-establishment, covering over 200,000 members of the armed forces, revealed that about 17% expressed a

[1] Minutes of Proceedings and Evidence, No. 1, March, 1942, p. 25

clear desire to return to the land when the war is over, farm electrification will facilitate their establishment upon the land. A farm electrification programme will make a special contribution towards solving the problem of re-establishing men drawn from the country districts. Unless they take up farming or find work in the districts from which they came, these men may move into the cities and aggravate an already acute labour situation.

Employment-Creating Power of Farm Electrification

This Commission had intended to make a thorough study of the number of men drawn from Manitoba into the armed services and war industries in order to secure some conception of the re-employment problem after the war. This effort was abandoned for several reasons: (1) time and resources were limited, (2) the war is still drawing more men so that figures of today may be out of date by the time the war is over, (3) the work of this Commission embodies only one aspect of post-war planning within the province, (4) national bodies are better able to reach sound conclusions upon the question because of their greater access to sources of information and, in any case, the scope of the post-war problem will depend largely upon the degree of success attained by national policy in sustaining prosperity. This Commission recognizes, however, that those responsible for over-all planning must have some conception of the scope of probable unemployment in the post-war period. The Commission is informed that Ottawa authorities are devoting attention to the quantitative aspects of this problem.

It appears certain that a Manitoba rural electrification programme will substantially stimulate industry in the rest of Canada, and by virtue of the increased market, should encourage manufacture of certain classes of material in Manitoba. This in turn will provide better markets for Manitoba's farm products.

The Department of Labor of the United States published a report showing how the R.E.A. programme stimulated private employment. The following is taken from this report:

> Incidentally, the programme has had a stimulating effect on private business in many lines. From the forests and pole treating plants in such widely separated states as Florida, Minnesota, Idaho, Georgia, and Tennessee have come the poles used to carry the wires. The wires, hardware, plastics, etc., used in erection of the line have meant additional business for the copper mines of Arizona, Michigan, Montana, and Tennessee; the iron mines of Minnesota; the steel plants of Pennsylvania and West Virginia; the wire plants of New Jersey; the aluminum smelters of Tennessee; manufacturers of electric meters, water pumps, electric light bulbs, plumbing, lighting fixtures, bathroom equipment, washing machines, refrigerators, radios, household appliances such as toasters, irons, vacuum cleaners, fans, ranges, etc.; innumerable articles of equipment for the farm, office furniture and equipment for the new co-operative associations, and the automobiles, maintenance trucks, tools, gasoline and oil used by them—all have benefited by increased business arising from the programme, and will continue to do so.
>
> An Ohio company manufacturing electrical pumps found itself so prosperous as a result of this new demand that it paid all of its 500 employees a bonus from the "plus" business.

This report further states

> The retail dealers in appliances and the electrical contractors have likewise enjoyed boom conditions. It is estimated that for every dollar invested in rural power lines the farmer spends an equal amount for wiring, plumbing and appliances. In one county in Wisconsin, it is reported 600 farms had been wired at an average cost of $400 before the project had completed eight months of operation. The wiring was paid for almost entirely in cash. Every electrician and electrical dealer in the area was busy for months. Also illustrative is the case of eight dealers in an Oklahoma town who added new lines of merchandise and employed new salesmen to handle their expanding rural business.

When a given sum, say $1,000, is spent upon public works the beneficial effects operate both backwards and forwards. If we assume that this sum is spent in Manitoba on rural electrification, approximately 25%, or $250, will be spent on direct labour erecting the lines within the province, the balance will be spent for material and supplies. The $250 becomes income for workmen. When they spend the funds at the grocery store, for example, a part of this expenditure will be used by the recipient to replace the stocks of goods sold, but part of the $250 will be net income for the grocer. He will spend it on his own living costs. Thus $250 spent by the province on direct labour may "turn over" several times, providing an income for numerous people in succession which is substantially in excess of the original $250.

The same analysis applies to the $750 spent upon materials and supplies. A long sequence of agencies are benefited: trucking companies, garages, railways, wholesalers and retailers, manufacturers, miners, and foresters. Sums received by each of these agencies or persons may be net or gross income to them. They meet their expenses out of the receipts and use the balance for living expenses, dividends, or savings, perhaps plowed back into the business.

It should be pointed out, however, that "leakages" may occur. For example, if pessimism as to the future prevails, the grocer may reduce his own plane of living, he may not replace the goods sold off his shelves. The worker may not feel sure of his job, so that he hoards part of his earnings either in the bank or at home. Or the several recipients of income may use part of the funds to extinguish debts previously accumulated. All of these responses to the province's effort to stimulate business and employment may defeat the purpose of the expenditures. Thus the beneficial effects of public expenditure may "die in their tracks" and fail to create the maximum amount of employment which would have resulted had optimism prevailed.

For this reason a public works programme must be bold, courageous, and of sufficient quantitative importance to create the necessary optimism. This can be done, as the war expenditures of the 1940's showed, by letting it be known in advance that the government proposes to make a sustained effort to take up all the slack in the labour market and that no one able and willing to work will be left jobless. With this assurance of a continuing market for its goods, private business becomes prepared to enter into long-

range commitments for the expansion of plant and equipment Such a courageous programme is less likely to be a heavy charge upon the public treasury (because of its success) than would be a half-hearted, inadequate policy which will inspire as much uncertainty as certainty of the future.

A Programme for Manitoba

To what extent a postwar rural electrification programme in Manitoba will create employment will depend upon the scope of the project. The Commission has come to the conclusion that the majority of Manitoba farmers are so situated geographically and financially[2] that power can be brought to them economically Manitoba has approximately 59,000 farmers. Some of them are submarginal, others are so widely scattered because of the large size of their farms or because of the presence of unimproved land that they cannot look forward to power in the immediate postwar period By way of illustration it should again be pointed out, however, that about 38% of the farmers in the United States have electric power, and the R.E.A proposes to bring this figure up to over 90% for the country as a whole. In a few states the present figure is already over 80%. The figure for Minnesota is at present about 32%, for Wisconsin over 50%, and for North Dakota about 6%.

This Commission recommends that the government embark on a programme of rural electrification designed to connect a minimum of 1,000 farms in the first year in the postwar period, regardless of general employment conditions,[3] and not less than 3,000 farms per year in case unemployment becomes widespread.

This programme based on 1939 prices would involve the following initial expenditures [4]

	1,000 Customers	*3,000 Customers*
Wiring buildings	$150,000	$ 450,000
Appliances	150,000	450,000
Line construction	673,000	2,019,000
Total.	$973,000	$2,919,000

These estimates are based upon a careful analysis of costs incurred by the Manitoba Power Commission, Of course, the Commission has no knowledge of what the price level of electrical equipment will be after the war, but takes the view that it is probable that it will be approximately that which pre-

[2]In view of the fact that farm electric power is to some extent a substitute for other costs and should raise net income by eliminating some costs entirely and in general promoting the efficiency of farm operations.

[3]Based on the view that Manitoba's farmers must be supplied with power if a healthy economy is to prevail.

[4]Experience shows that with the passage of time additional investment is made in appliances.

vails at the time of writing. A major change in wage rates, construction and manufacturing costs obviously would alter the figures, so they must be viewed as illustrative only.

Furthermore, what the typical farmer will spend upon wiring and appliances will depend on prices and the degree of farm prosperity. It has been assumed that it will cost on the average $150 to wire fully the farm buildings.[5] It has been further assumed that the typical farmer will spend not less than $150 on farm and domestic appliances.

We have also assumed that electrification will require an investment per farm of about $675 in rural line along the highway and from the highway to the farmer's yard pole. No doubt construction will be expanded first into the most densely populated territory where there are about three farmers per mile of line. This will reduce the investment *per farm* for roadway lines, but because of the greater prosperity and greater need for electricity in some of these territories it is possible that the farmer will make a larger investment in wiring and appliances. It should also be pointed out that while a greater density of farmers per mile will reduce the investment in line *per farmer* it will increase the total investment *per mile* because in most instances a separate transformer has to be installed for each farmer.

We have assumed that approximately 25% of the investment in wiring and about the same proportion in line construction will be spent upon direct labour. Thus, of the minimum figure of $130,000 to be spent upon wiring, $37,500 will go to Manitoba citizens as wage workers engaged in wiring of houses and barns. The appliances may be manufactured chiefly in other parts of Canada and the United States so that people in Manitoba will receive only indirect benefit from the expenditures outside of the province; however, retailers, wholesalers, and transportation agencies in Manitoba will receive some direct benefits from this part of the programme.

Unquestionably some electric line equipment, and probably some electrical appliances will be manufactured in Manitoba. In co-operation with manufacturers, the Industrial Development Board of Manitoba has made an analysis of every item necessary for rural line construction as well as appliances and apparatus to be used on the farms, with a view to determining which items could be manufactured in the province. The Board reports to this Commission the items which probably cannot be manufactured on an economical basis in the province and those which can. Approximately one-third, in dollars, of the requirements can be produced in the province according to the investigation of the Board. Several eastern companies are reliably reported to be considering the erection of western branch plants, if the farm electrification programme is inaugurated. Some Manitoba manu-

[5] A study made in Iowa in 1939 showed an average investment in wiring of $137.30 per farm (Iowa State College Bulletin).

facturers have stated that they are prepared to install the necessary equipment to produce electrical supplies.

If the people and Government of Manitoba show a firm and convincing resolve to embark on a *sustained* farm electrification programme for a decade or longer, this will be the necessary assurance to local manufacturers to induce them to equip their plants to meet this new development. It may be suggested, that if Manitoba embarks upon the programme as recommended in this report similar developments, perhaps not of the same proportions, will take place in Saskatchewan and Alberta. Furthermore, if businessmen and other community leaders will determine for themselves that farm electrification will help to place Manitoba agriculture on a more solid basis, as suggested by this Commission in Chapter IV, they will be inclined to go much farther in an industrialization programme than would otherwise be the case. Therefore, the number of man-hours of labour and the size of industrial payrolls which a farm electrification programme will create depends in part on the response which Manitoba's industrialists, bankers, and other community leaders will make to this problem.

Of the $673,000 to be spent annually as a minimum on line construction, Manitoba citizens would receive about $168,250 as direct wages for line work. The direct benefit of the other $504,750 may go chiefly to manufacturers in other parts of Canada, reduced by such manufacturing as will be done in Manitoba.

In addition to the expenditure of the above sums for wiring and line construction, it is estimated that of the $500,000 to be spent annually for five years for the development of the basic network of lines to bring power to towns and villages, about $378,000 will be spent on new equipment in each of five years until all communities of 20 persons and over are supplied with power.

Thus the farm and urban-farm programme will involve in the first year a combined annual expenditure as follows:

Wiring farm buildings	$ 150,000
Appliances for farmers	150,000
Farm lines	673,000
Urban-farm network	378,000
Appliances and wiring in hamlets and villages	350,000
Total	$1,701,000

Depending somewhat on the amount of unemployment prevailing, it is proposed that the number of farms to be electrified in each year after the first be increased by 500, until in the fifth year 3,000 new farms be supplied with power, thus the first three items in the above tabulation will be increased accordingly.

Ultimately 70 to 85% of all costs are labour costs. This is true not only of direct labour expenditures in building lines and wiring houses and barns, but also of money spent on transportation and on materials and supplies. Thus, under the minimum programme of a $1,701,000 expenditure, about

$1,275,000 would accrue to wage and salary workers annually If widespread unemployment prevails, a doubling or tripling of the expenditures would add proportionally to this project's ability to create employment

Comparable figures from the R E A show that from May, 1939, to April, 1940, the construction of about 109,000 miles of lines provided approximately 294 5 man hours of employment per mile This labour was classified as 70% unskilled, 14 5% skilled, and 0.5% supervisory Wiring required approximately 25 man hours per house

Figures on employment created in the manufacture of wire, apparatus, and appliances are exceedingly difficult to obtain. As a rough approximation manufacturers estimate that for every 100 hours of employment in line construction the manufacturers are called upon to produce equipment requiring about 300 man hours of work In the United States it is generally assumed that for every $1,000 spent on line construction an additional $1,000 is spent by consumers for wiring, appliances and equipment (other than line construction apparatus) within about three years One study made by the R E A showed that by the time the R E A had allotted $82,000,000 for line construction, an additional amount of $85,000,000 had been spent by consumers for equipment and appliance items. This figure approximates the above estimate of dollar-for-dollar expenditure for appliances as compared to line construction expenditures

The incomes of Manitoba farmers are somewhat lower than those of farmers in the United States, and electrical appliances and equipment have been more expensive in Canada than in the United States For this reason we have assumed a smaller expenditure by Canadian farmers on equipment. If postwar prices for appliances can be reduced to about those prevailing in the United States, Manitoba farmers would be prepared to acquire more appliances than those we have assumed

Conclusions

From the foregoing analysis it is clear that a farm electrification programme is ideally suited to induce postwar employment because it will stimulate a broad range of industries. It will stimulate the copper, aluminum and iron mining industries. Poles and cross arms will be required from the timbered areas The heavy industries producing transformers and sub-station equipment will receive large volumes of work The lighter electrical appliance industries will receive orders for hundreds of thousands of dollars worth of equipment. It will create employment in Manitoba

The benefits of this employment programme will not be confined to Manitoba but will extend to many parts of the Dominion. For these reasons, along with the fact that it will be of substantial benefit to Manitoba's agriculture, this programme should find general support not only in Manitoba but throughout the country and especially by the authorities at Ottawa.

CHAPTER VI

THE PROGRESS OF FARM ELECTRIFICATION

This Commission has made a study of the progress of farm electrification attained in a number of different countries in order to find ways and means of accelerating farm electrification in Manitoba.

Summary

1 In most western European countries from 50 to 98% of all farmers are supplied with electric power

2. Farm electrification is a development which has taken place largely since the first World War

3 Privately owned electric companies generally are not in a position, by the very nature of their organization, to promote farm electrification on a large scale

4 Farm electrification is regarded as socially and economically desirable in both democratic and authoritarian countries.

5. In few countries has a high saturation of farm electrification been achieved without state aid, both in organization and in the form of a bonus.

6. Generally, farm electrification can make satisfactory progress only if the revenue per mile of line is maintained at a maximum by all farmers becoming customers.

7 If electricity is brought to farmers at a price which they can afford to pay, they respond to such a degree that the system may generally in time be made self-supporting, or virtually so [1] Whether this would be true in Manitoba cannot be determined with certainty in advance of the accomplished fact

Development of Farm Electrification Outside Canada

Statistics on farm electrification are meagre, and at best ambiguous.[2] Nevertheless, the following data will at least give a rough conception of the progress of the movement.

According to Marquis W Childs[3] about 50% of the agricultural area of Sweden is electrified, but approximately 75% of the farmers are supplied with central station energy [4] In Denmark 85% of the farmers have electric

[1] Apparently on this theory, in Nova Scotia only initial subsidies are provided.

[2] In Canada, for example, the Census defines a farm as a tract of one acre and over, while in the United States the figure is three acres.

[3] *Sweden, The Middle Way*, 1936.

[4] Third World Power Conference, Washington, D C., 1938, p. 696.

power The figure for France and Germany is about 90% and for Holland it is 98%. In New Zealand energy is available to about 93% of the population, the figure for strictly farm areas being only slightly lower [5]

In the United States nearly two in every five farmers are supplied with electric power [6] This growth is largely a development of the last decade. Because of many similarities between the United States and Canada, and because of the growing interdependence of these two neighbours, Table 5, showing the degree of saturation attained in the several states, is reported in full for 1934 and for 1941

TABLE 5 PERCENTAGE OF FARMS SUPPLIED WITH CENTRAL STATION ELECTRICITY IN THE UNITED STATES, 1934 AND 1941

State	1934	1941	State	1934	1941
United States	10 9%	38 6%			
Alabama	4 0	21 5	Nebraska	7 1%	24 8%
Arizona	29 6	36. 3	Nevada	25 6	46 4
Arkansas	1 2	14. 3	New Hampshire	53 7	77 4
California	53 9	64. 3	New Jersey	51 6	68. 9
Colorado	11 2	39. 0	New Mexico	3 3	16. 5
Connecticut	31 5	55 4	New York	32 7	73 8
Delaware	17 3	53 5	North Carolina	3 2	34 5
Florida	7 8	29 5	North Dakota	2 3	6 4
Georgia	2 8	30 2	Ohio	18 8	70 1
Idaho	20 8	72 8	Oklahoma	2 6	17 0
Illinois	12 8	52 5	Oregon	27 5	68 7
Indiana	11 7	67 0	Pennsylvania	25 6	66 3
Iowa	14 4	50 9	Rhode Island	45 6	84 7
Kansas	7 6	22 1	South Carolina	2 3	33 4
Kentucky	3 0	20 8	South Dakota	3 5	8 3
Louisiana	1 7	13 8	Tennessee	5 6	30 3
Maine	33 3	55 3	Texas	2 3	27 5
Maryland	15 3	52 1	Utah	52 5	75 2
Massachusetts	41 3	86 3	Vermont	29 4	62 4
Michigan	21 4	77 1	Virginia	7 6	31 3
Minnesota	6 8	35 1	Washington	47 5	81 2
Mississippi	0	12 6	West Virginia	3 5	30 3
Missouri	3 4	23 9	Wisconsin	19 6	54 5
Montana	5 5	24 0	Wyoming	3 0	30 5

Source: Edison Electric Institute and R E.A

The striking fact revealed by this table is that since 1934 the number of farms in the United States supplied with electricity has increased by several times, and the figure now stands at 38 6%. The increase is spread generally over the entire area. Even such areas as Texas, Kansas, and Nebraska, with large farms and heavy concentration in grain farming, have made remarkable progress, the respective figures of saturation for these three states being 28, 22, and 25%

PROGRESS IN CANADA

The Census of Canada for 1931 and 1941 reported the number of farms receiving electric service as given in Table 6. It should be emphasized that

[5] *Contemporary New Zealand*, New Zealand Institute of International Affairs, p. 48.
[6] Edison Electric Institute, *Statistical Bulletin*, No. 9, 1941, p. 31

TABLE 6—FARM ELECTRIFICATION IN CANADA 1931 AND 1941

Province	Per Cent of Farms Electrified 1931	1941
Canada..		19.8
Prince Edward Island	3.5	5.4
Nova Scotia	8.8	26.0
New Brunswick	5.6	18.8
Quebec	15.2	23.3
Ontario	12.6	37.0
Manitoba	2.3	7.3
Saskatchewan	1.4	4.7
Alberta	1.7	5.4
British Columbia	21.8	35.8

Source Census of Canada Figures include wind and gasoline electric charger plants. Figures for 1941 are preliminary and based on a 10% sample

these figures are not confined to farms receiving central station energy but also includes those farms which supply themselves with a small wind or gasoline generating plant. The prairie provinces show low saturation, the figure for Manitoba being 7.3%, less than 30% of these were supplied with central station hydro electric energy. The following discussion is based on the farms receiving central station energy

In *Prince Edward Island*, out of about 12,240 farmers, 644 are reported as having electric power, this constitutes about 5.3% of the total. About two-thirds of this number are supplied by the Maritime Electric Company of Charlottetown with 408 customers. The Scales Hydro Electric Company of Freetown supplies about 90 customers, and C. W. Ives of North Tryon supplies 85 farmers. The other 66 customers are supplied by numerous other systems, the several suppliers having from 3 to 15 farm customers. Premier Thane A. Campbell informs this Commission that serious consideration is being given to an expanded programme for the postwar period.[7]

Accurate data for *Nova Scotia* have not been obtained. The Avon River Power Company supplies power to about 3,800 farmers. The Nova Scotia Power Commission supplies about 6,000 so-called rural customers divided as follows

Villages and hamlets	1,000
Seasonal customers	500
Storekeepers, garages, etc.	500
Fishermen and farmers	4,000

Mr. E. J. Cragg, Commissioner-Manager of the Nova Scotia Power Commission, estimates that about 60% of the last group are fishermen-farmers. Other utilities supply power to additional farmers but accurate data were unobtainable. Thus it would appear that of the 33,000 farmers in the province not less than seven or eight thousand are supplied with electric power, or possibly about 25%.

[7]Letters from Premier Thane A. Campbell to the Commission.

In *New Brunswick*, the New Brunswick Electric Power Commission, a public body, is serving approximately 16,500 rural customers, of which about 10% are summer residents. Of the balance probably 80% could be classified as farm services, it is estimated that this would include about 70 to 75% of the total number of farms in the Commission's territory. There are about 31,800 farmers in the province.

In *Quebec* the Public Service Board reports that out of a total number of 147,000 farms in the province approximately 25,000, or 18%, are supplied with electric power. This is an increase of about 33% since 1936. Of this number the Shawinigan Water and Power Company supplies about 16,000, and has a saturation of about 27.5% in its territory. The Montreal Light, Heat and Power Consolidated serves about 850, a saturation of approximately 85% in its territory. The Southern Canada Power Company, Montreal, supplies current to nearly 2,000 farmers. The Quebec Power Company serves about 3,200 farmers; the Gatineau Power Company has 3,000 farm customers. The balance of the customers are served by other organizations. It might be added that under the laws of Quebec relating to rural electrification, whenever a municipal corporation cannot agree with a public service company upon terms for obtaining electricity, the Public Service Board of Quebec may order the company to extend its service under terms and conditions ordered by the board.

In the case of *Ontario*, the 160 operating rural power districts of the province deliver energy to about 151,500 rural customers, of whom approximately 59,000 are classed as farm customers. The Ontario Hydro Electric Power Commission estimates that of the nearly 200,000 farmers, approximately 75,000 are within a range that will ultimately permit the extension of service. In addition to the farms served by the Ontario Hydro Electric Power Commission, service is brought by other organizations to additional farmers, but this Commission has no specific data on this matter.

In *Saskatchewan*, the Saskatchewan Power Commission serves about 126 towns and villages and somewhat over 100 farms from its system. Other utilities serve possibly another 155 customers, making a total of less than 300 of the 139,000 farmers in the province. It might be added that in 1939 there were some 8,000 farmers in Saskatchewan who had installed their own electric light plants at an expense of about $1,000 each.

In *Alberta* about 505 farmers out of a total of 100,333 are served with electric power, or about one-half of one per cent, as indicated by Table 7. An examination of this table suggests that to date there has been no concerted movement to bring power to the farmers of Alberta; rather such expansion as has taken place has been incidental to urban developments.

In *British Columbia* with 26,000 farms, the British Columbia Electric Railway Company supplies about 17,000 residential services in the rural section of the lower Fraser Valley. Of this number approximately 50% are

farm services, the company having a saturation of farm electrification in this area of approximately two-thirds. In addition other companies provide some services, but no specific data has been available.

TABLE 7 FARM ELECTRIC SERVICE IN ALBERTA

Utility	No. of Farms with Service
Calgary Power Company	372
Canadian Utilities Ltd.	60
City of Lethbridge	34
City of Calgary	22
City of Edmonton	5
Forest Lawn Power and Light Co.	3
City of Medicine Hat	2
City of Red Deer	2
Town of Ponoka	2
Town of Vermilion	2
Town of Macleod	1
Total	505

Source: W. D. King, Deputy Minister of Trade and Industry, Edmonton.

PROGRESS IN MANITOBA

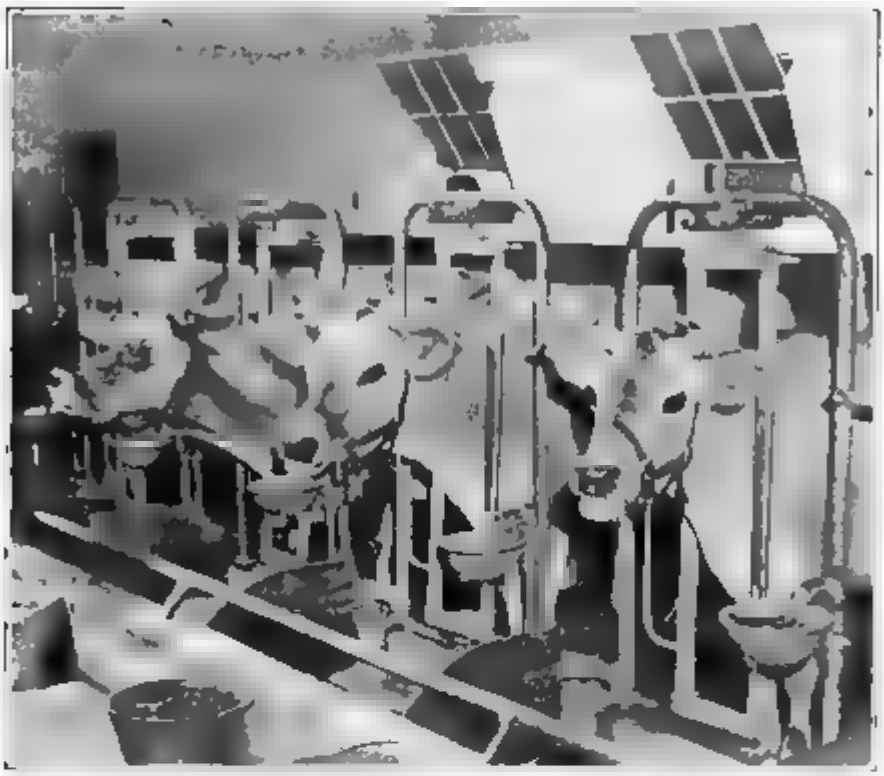
A detailed history of the development, organization, administration, and finances of the Manitoba Power Commission may be found in a report prepared in 1940 by Mr. H. Carl Goldenberg, and therefore need not be repeated here.[8] It will be sufficient to note that in 1919 the Manitoba Power Com-

TABLE 8—NUMBER OF FARMERS SUPPLIED WITH ELECTRIC POWER IN MANITOBA

Year Connected	Manitoba Power Commission	Winnipeg Electric Company	Winnipeg Hydro Electric System	Other Utilities	Total
1942	67	20	1	3	91
1941	28	32	4	2	66
1940	56	35	2	2	95
1939	116	30	1	2	149
1938	165	34	1	4	204
1937	27	23	5	2	57
1936	9	44	3	1	57
1935	5	9	2	1	17
1934	4	9	6		19
1933	2	10	3		15
1932		21	4		25
1931	2	24	2		28
1930	2	21	1		24
1929	22	10	2		34
1928	5	10	3	1	19
1927	19	4	3		26
Prior to 1927	26	102	46	3	177
Year not stated	6				6
Total	561	436	99	21	1,109

Source: Survey conducted by Manitoba Electrification Enquiry Commission. For this survey farms of less than five acres were excluded.

[8] *Government Commercial Enterprises Survey*. King's Printer, Manitoba, 1940.



The Modern Dairy Must Have Electric Power

mission was created for the purpose of making electric power available to the non-Winnipeg area. In this period of time the power commission's net assets have grown to about $7,000,000. To date, however, primary attention has been devoted to developing a transmission grid, so as to bring power to hamlets, villages, towns, and cities. In 1942 the Commission was serving in excess of 150 settled communities, 15 airfields and military camps. Prior to 1928 less than 60 farmers were served by the Commission. In the middle 1930's little progress was made, but since 1937 a number of farmers have been connected, reaching a total of 561 by 1942. In addition, the Winnipeg Electric Company serves 438 Manitoba farm customers and the Winnipeg Hydro Electric System serves nearly 100, as indicated in Table 8, making a total of about 1,109 farmers or 1.9% saturation.

It should be emphasized that the above survey of farm electrification in Canada does not pretend to be complete. Rather the purpose has been to show the degree of interest shown in this movement in the several provinces and the approximate status of the movement throughout Canada.

Private Utilities and Electricity on the Farm

Generally speaking, privately owned electric companies have not been able to bring power to farmers on a large scale, although in Quebec and British Columbia better than average progress has been made. In the territories around large cities, in areas where small farms engaged in market gardening predominate, the private utilities have made substantial progress. But almost nowhere in the world have private utilities been able to secure a high saturation over any large area.

This is no condemnation of private enterprise. Rather it must be emphasized that by the very nature of their organization and character, it is not practical for private utilities to bring power to farmers on a large scale. Rural lines are expensive to build because distances between customers are large. Maintenance and meter-reading activities are expensive under these circumstances. Private utilities usually have to pay more for borrowed capital than do states and are subject to taxation.

The state, on the other hand, not only gets the benefit of low capital costs but because of its authority can require more readily that customers read their own meters, bill themselves, and thus save annually on this item alone $2 to $3 per customer. Again, the state can place the poles along the highway just inside the farmer's fence upon the farmer's land, and get the right-of-way free of all charge, a privilege which private utilities could scarcely ask of the farmer. Legal expenses of private companies inevitably are higher than for publicly owned lines. If the lines and generating equipment are in private hands, they are assessed on the tax rolls. If they are owned by the state, they usually are tax free, a gain to the users, though not necessarily a gain to the taxpayer.

Thus, when we state that our study shows the failure of substantial or comprehensive expansion into farm areas by private utilities, this should not be regarded as condemnation of private ownership *per se*, rather it is evidence that private companies, organized and operated as they are simply are not adapted to a complete job of rural electrification. Furthermore, the state is in a position to bring electric power to marginal customers who under private ownership would ordinarily be left unserved. Public ownership is generally not operated as a commercial enterprise and does not have to show a profit on all its business; therefore the state is in a position to expand coverage to areas which are out of the reach of a private company, on the theory that, within limits, electric power is a service which the farmer should have.

Bonuses for Farm Electrification

In addition to tax abatement, farm electrification has received direct state aid in most areas where it has made substantial progress. Where subsidies have not been provided the development has been slow and is generally regarded as unsatisfactory, though there are some exceptions to the above statement.

Where a high density per mile of line can be secured, subsidies have not been necessary. In England, for example, subsidies have been granted sparingly. In France the state subsidized rural capital costs, the subsidy ranging from 30 to 50%, in addition, the majority of counties furnished some subsidy.[9] R. Preaud of the Ministry of Agriculture of France, justifying the aid, said "The state defends its interests in fighting against the desertion of the countryside." Czechoslovakia provided subsidies for farm electrification beginning in 1924.

In some instances, instead of a subsidy being furnished from general revenues of the state, an indirect subsidy is provided by making up any initial losses in the rural areas through profits in the more prosperous areas of the publicly owned electric system. Thus in the Netherlands:

> In electrifying the country no financial aid from the public treasury is given, as it is understood that the electrification of each district should be self-supporting. If there are doubts concerning the balance of the working account a guarantee is asked from the consumers in the district which is to be electrified. When this guarantee cannot be given in full, the losses to be expected in the first years can be met by a fund into which each year a part of the profits of the provincial undertakings is deposited. Owing to these measures, about 98 per cent of the Dutch population is connected with the low-tension networks.[10]

Subsidies in the United States

In the United States rural electrification made only moderate progress until 1935, when the national government commenced making loans to local co-operative groups of farmers at 3%, or less, also providing some promotional facilities. At present the R.E.A. lends money required by local groups of farmers for (1) the building of lines, (2) wiring buildings, (3) buying appliances, and (4) in case it is necessary, also for constructing generating stations. The administrative expense of organizing and promoting the co-operatives and handling the funds amounts at present to about $3,300,000 (1941 and 1942) annually and is borne by the national government. The funds advanced amounted to $360,000,000 from 1935 to September 1942. The R.E.A. does not operate the system but keeps close supervision of operating and financial matters. The loans are repayable in full over a twenty-five-year period at an interest rate which is equal to the rate which the national government itself has to pay on its borrowings of a maturity of ten years and over, a current rate of about 2.46%. Gross revenues of the co-operatives in 1942 were running at the rate of about $50 million annually, or about 13% on the investment. Of the $61 million due from the co-operatives up to the end of August 1942, all but about $194,000 were paid off, however many co-operatives are paying in advance so that collections are running about 125% of the amounts due. In most instances the R.E.A. co-operatives, of which there are now about 900, either pay no taxes at all or are eligible for some reduction

[9] Third World Power Conference, 1936.
[10] *Ibid.*, p. 994.

in the tax rate which would apply to them were they not sponsored by the government. Lines generally are built on farmers' land and in no case may the R.E.A. co-operatives pay for this right-of-way.

Subsidies in Canada

Of the Canadian provinces, Ontario, Nova Scotia, Quebec, and Manitoba make direct subsidies to farm electrification, although at one time New Brunswick paid any monthly service charge in excess of $1 levied against the consumer in rural districts.

In *Nova Scotia* a public power commission created in 1920 is serving a substantial area of the province. Little progress in farm electrification was made, however, until a system of subsidies was established in 1937.[11] Aid from the general revenues of the province up to $9 per customer per year is provided to help meet the service charge, in order to ensure that no domestic customer shall pay more than $15 and no commercial customer more than $21 a year for this part of his billing. For 1941 the legislature appropriated $36,000 for this purpose, and $43,000 in 1942.

In addition, the law of 1938 makes available from general provincial revenues, for approved line extensions of the commission, the difference between annual cost and annual revenue, provided the equivalent of three contracts of domestic classification per mile are available initially and that there are also present enough potential customers to provide, when connected, sufficient revenue for annual costs. The subsidy is looked upon as a temporary aid until high saturation is attained. In 1941 the legislature appropriated $39,000 for this purpose, and $50,000 in 1942.

Furthermore, in the case of private or municipally owned utilities interested in promoting a rural line, a subsidy from general provincial revenues may be secured. If such a proposed extension averages six potential customers per mile, and an average of three customers contract initially for service, the utility may claim aid to the extent of the difference between the amount of five minimum bills per mile and the total of actual billings per mile, providing such difference does not exceed the sum of two minimum bills per mile. In 1941 the legislature appropriated $7,400 for this purpose, making a total of about $82,000 for all three types of subsidy in 1941, and $105,500 for all purposes in 1942.

In 1941 the subsidy of $60 per mile was paid to private utilities in connection with the construction of 16 miles of line. This aid is provided annually so long as the governor-in-council deems it necessary.

In the four and a half years since 1937 the power commission has completed 853 miles of rural line eligible for aid, this would have amounted to $80,934 if all the lines had been put into operation simultaneously. In the

[11] Analysis based upon annual reports of, and correspondence with, Nova Scotia Power Commission.

same period private and municipal utilities constructed about 230 miles of line, for which the maximum possible annual aid would have been $13,764 if put into operation simultaneously, or about $58 per mile of line. The power commission in 1941 had 5,725 rural retail customers.

In *Quebec* on the recommendation of the Public Service Board and on an order of the lieutenant-governor in-council, the provincial treasurer may pay to any municipality a sum not exceeding 50% of the capital cost of constructing and establishing lines and main transmission cables, transformers, meters, and secondary electric service lines on the public highway required for the delivery of power in any rural municipality. In addition, the treasurer may loan an additional sum not exceeding 25% of such capital cost for a period of thirty years, with interest at 4% per annum.

Although the above provision has been in effect since 1936, the province has paid out under it only $19,000 for service to three municipalities, Rock Forest, St. Catherine de Hatley, and Sennetertre. The progress of electrification under this scheme is not regarded as satisfactory by the authorities, the chief reason given being that farmers or farm municipalities hesitate to involve themselves in the business of distributing energy.[12]

In *Ontario*, the Hydro Electric Power Commission had been in operation for fourteen years before any substantial number of farmers secured power. The real impetus for farm electrification was provided in 1921, when the province agreed to pay one-half the capital cost of rural lines. This had the effect of reducing the service charge to farm customers from $6.80 to $5.07 per month net. There was an immediate response which necessitated construction of a very considerable mileage of rural lines, an event that really marked the beginning of rural service throughout the province. Extensions were made under this plan without change in the basic principle until 1924. However, in that year the government amended the existing legislation by providing a grant in aid or bonus of 50% of the entire cost of both primary lines and secondary equipment used to distribute power in agricultural communities, though not including wire and poles and labour for their installation in the farmer's lane. This brought about a lowering of the farm service charge from $5.07 to $4.10 per month net and, needless to say, had an immediate further stimulus in spreading rural extensions. By 1928 the commission had about 9,000 farm customers.

Many of the older rural power districts had by this time obtained a very considerable growth and were commencing to show net surpluses over annual operating costs, causing in many instances a substantial lowering of the rates for both service and consumption charges. As the net operating surplus in a rural power district is credited to the district which created it, it became necessary in a few years to return to the consumers a portion of the surplus, in the form of cash or credit on their bills. The popularity of rural

[12]Data and information from the Quebec Public Service Board.

electric service grew so rapidly, owing in no small measure to the lowering of rates, that in 1930 the legislature again passed an act, an extract from which is as follows: "Where such minimum service charge in the case of any rural power district is not sufficient to meet the necessary cost of service as specified by the Commission the deficit shall be chargeable to and payable out of the consolidated revenue funds." Among other things, it provided that the maximum service charge to be paid for farm service was not to exceed $2.50 per month net, and if a deficit resulted from such service charge, it would be chargeable to the province, to be paid out of consolidated revenue. Further reductions were made in 1936 and 1937, so that the service charge is now generally a maximum of $1 per month net.

By 1941 the province of Ontario had made grants-in-aid to rural electrification amounting to $25,500,000 for approximately 20,000 miles of rural lines. Thus this sum amounted to about $1,175 per mile of line, including local transmission lines, a sum which exceeds the expected total cost of a mile of farm line in Manitoba. The other half of the construction capital was raised by the power commission and becomes a charge against annual operations. The above subsidy, it should be pointed out, applies to "rural" lines and not only farm lines, that is, hamlet customers in the unincorporated areas are benefited by the subsidies. In a few instances incorporated villages have de-incorporated in order to get the benefit of the subsidy. The total number of hamlet customers in 1941 was about 63,000 and the number of farm customers about 59,000, or a total of 122,701. Thus a subsidy of about $190 per customer was provided toward capital construction.

In Ontario, because of the relatively small farms and the greater number of hamlets, the density along the lines is about six per mile of line. Although the Manitoba Power Commission already serves over 150 urban communities and will extend its service to others in the postwar period, it is not probable that it will be able to attain a density as high as that in Ontario, even though a large-scale farm electrification programme is embarked upon.

Subsidies in Manitoba

Prior to 1939 no subsidies were provided in Manitoba. In that year the Hon. D. G. McKenzie, then Minister of Mines and Natural Resources, announced a new policy in respect to rural hydro in which he stated that the government had decided to

1. Pass legislation providing for the payment of one-half the capital cost of all transmission lines, including (a) the line to Brandon, (b) new lines to all towns in Manitoba, (c) all farm lines, (d) lines already constructed.

2. Provide facilities which will permit the construction of transmission lines on this basis in all parts of Manitoba within seven years.

3. Assist lines in the Dauphin, Gilbert Plains, and Grandview district, and in the Swan River Valley with the same bonus in order that they may build up sufficient power loads on their local systems to make it economically feasible to connect up these territories at an early date.

In accordance with this new policy the Electrical Power Transmission Act was amended by Chapter 19, 1920, S.M., providing for the payment out of water power rentals of not more than 50% of the sinking fund and interest charges on capital expenditure for generation and transmission.

In 1930 approximately 325 miles of transmission line were constructed and a number of towns, villages and farms were connected to the system. The economic depression of the 1930's subsequently retarded development until the latter part of the decade. From then until the beginning of the second World War the Manitoba Power Commission made substantial progress and might have been able to make reasonably satisfactory progress under its existing organization and subsidy had peace and prosperity continued.

Since 1929 the annual subsidies provided to the power commission for rural line expansion have averaged about $113,000, totalling about $1,354,000 for the entire period, as indicated in Table 9. In 1941 the subsidy amounted to about $8 per customer, chiefly urban users, though including all classes of users.

TABLE 9—BONUSES PAID TO THE MANITOBA POWER COMMISSION*

Year	Amount	Year	Amount
1930	$ 47,083 38	1937	$ 111,153 93
1931	67,623 46	1938	112,991 57
1932	100,111 01	1939	116,406 78
1933	104,271 17	1940	123,187 86
1934	104,797 77	1941	127,292 62
1935	105,048 67	1942	127,510 97
1936	106,426 04	Total	$1,353,890 13

*For the fiscal year ended April 30.

CONCLUSIONS

The foregoing brief survey will give the reader a general picture of the development of farm electrification in the last two decades. In nearly every country substantial progress has been made. Except in Quebec and Ontario progress in Canada has been less rapid than in most other advanced countries. Manitoba since 1919 has made a vigorous effort to expand power, first to urban communities, in the immediate postwar period plans should be ready to bring power to the farm.

This Commission adopts the view that the present policy of providing a subsidy of 50% of the capital costs, amortization and interest on generation, transmission and substation equipment is adequate to accomplish a thorough going farm electrification programme. However, it should be noted that if a vigorous expansion programme is embarked upon, the annual water rentals, now yielding about $188,000 annually, from which the subsidy is paid, will not be sufficient to provide the 50% subsidy on the enlarged programme. This point is discussed in chapter IX.

CHAPTER VII

DO FARMERS WANT ELECTRIC POWER?

This Commission made a special effort to find out whether the desire for electric power among Manitoba farmers was sufficiently great to justify the development of a farm electrification programme. In the first place, the Commission, through its field investigators, interviewed 500 farmers in seven typical townships scattered widely throughout the province. Secondly, the Commission announced through the *Manitoba Gazette* that it was prepared to receive submissions from interested persons. Through this means evidence of the attitude of farmers toward electric power was secured both from individual farmers and from farm leaders. Thirdly, a careful study was made of requests for power recently received by the Manitoba Power Commission. Finally, in order to gain some impression of the experience of the United States in regard to the attitude of American farmers toward electricity, a questionnaire was submitted to all R.E.A. co-operatives in Minnesota and North Dakota. Many discussions were held with the R.E.A. officials and a careful analysis made of their printed records.

Manitoba Electrification Enquiry Commission Survey

Although it was clear to the Commission that the farmers of Manitoba were anxious to see farm electrification extended in the province, it was decided that a sample survey be made of Manitoba farms in order to determine more definitely the intensity of the desire for electricity. To this end the Commission, with the aid and advice of the Manitoba Department of Agriculture, chose seven representative townships and interviewed every farmer situated within those townships. As a result of the interview, the investigator was asked to indicate the extent of the farmer's desire for electric power. The results of this survey are indicated below:

Anxious to have electric power	58%
Interested in having electric power	25
Might consider electric power	10
Indifferent	7
Total	100%

It will be noted that almost 60% of the farmers interviewed were anxious to obtain electric power. Among this group there are many farmers who have already made formal requests for power or have discussed the question informally with representatives of the Manitoba Power Commission. The second group, those described as interested in having electricity on the farm, have also in many cases made enquiries as to the probable cost of obtaining service. Most of these farmers are familiar with the uses to which they could put electricity on the farm. With respect to 83% of the farmers interviewed,

therefore, it may be hoped that no substantial amount of persuasion would be required in order to sign them up in an expanded programme of farm electrification, providing their incomes are not unduly depressed

Of the remaining farmers interviewed, 10% might consider electricity, but were not certain under present conditions Some felt that the poor state of their present buildings made it unwise for them to consider wiring them. Others were uncertain about whether they would remain on the land In still other cases the income of the farmers was such that no additional costs could be incurred, or if enough cash did become available, they felt that there were investments which took priority over electricity

A small group of farmers, constituting 7% of those visited, were indifferent to the possibilities of obtaining electric power Some had only recently taken up farming, while others were planning to retire in the near future and were therefore not concerned about the question

In general, the conclusions which may fairly be drawn from these interviews indicate that 80 to 90% of the farmers desire electric power In some areas, depending in part upon the racial stock predominating, the desire is less intense than elsewhere. In developing a farm electrification programme for the different regions of the province, the Manitoba Power Commission undoubtedly would be guided somewhat by these varying degrees of desire. It must also be remembered, in the planning of such a programme, that to be effective, desire must be coupled with the ability to pay for the use of energy

The validity of the above conclusions rests, in part, on intangibles It should be noted that the farmers were not asked to record their attitude toward electricity, rather the Commission's trained investigator was asked to record his impression of the probable response of the farmer to electric power under normal conditions of price, farm incomes, etc Should conditions in the postwar period change, the results of the investigation would require reappraisal.

Requests Received by Manitoba Power Commission

The Manitoba Power Commission has not been able in any year, to bring power to as many farmers as have requested it This was particularly true during the three years before the present war Between 1939 and 1941 at least 720 farmers made formal requests for power Very few of these requests could be satisfied. Thousands of farmers have made enquiries in informal conversations with the representatives of the Manitoba Power Commission. In numerous instances small groups of farmers have signed petitions asking for the extension of service.

This evidence of an active desire for electricity on the part of Manitoba farmers is reinforced by the reports to this Commission of several legislators regarding sentiment in their districts All point to the same conclusions,

namely, that the individuals who are ultimately to benefit from an expanded programme of rural electrification are beyond the stage where they have to be convinced of its advantages.

Experience in the United States

In order to discover the type of response which Manitoba farmers might be expected to make to a farm electrification programme, a careful study was made of the experience of the R.E.A. in the United States. By means of a questionnaire specific information was obtained from R.E.A. co-operatives in Minnesota and North Dakota.

In the United States, when a new co-operative is organized or a new line built, all the farmers are canvassed for the purpose of inducing them to take service. In reply to questions regarding the response of farmers, American officials reported that little difficulty was encountered in getting four out of five or nine out of ten to sign up immediately. In some of the poorer areas the response has been less satisfactory, but even in these cases the R.E.A. co-operatives are of the view that within two or three years a general saturation of 90% or over will be achieved.

In the questionnaire submitted by the Commission to R.E.A. co-operatives in Minnesota and North Dakota, this question was asked: What percentage of farmers within 1,000 feet of existing lines have signed up for energy? Replies to this question were received from 29 co-operatives. These are analyzed in the following tabulation:

Percentage Signing Up for Energy	*No. of Co-operatives Reporting*
90% and over	13
80 to 89.9%	6
70 to 79.9%	6
Less than 70%	4
Total	29

It will be seen that in 13 co-operatives nine or more farmers out of every ten situated within 1,000 feet of existing lines have signed up for service. In only four co-operatives was the level of customer saturation less than 70%.

Attitude of Farmers with Private Electric Plants

Any factor which makes farm operators reluctant to sign up for energy constitutes a barrier to the development of a general farm electrification programme. It might be expected, for example, that in an area in which a large number of farmers operate private electric plants, the degree of customer saturation would be so low as to make it impossible to bring electric power to that area. A similar question might arise in areas where the proportion of tenants is large. The problems to which these factors give rise have been investigated by this Commission. They are discussed below.

We are justified in assuming that where farmers have seen fit to make the substantial investment required for the acquisition of a private gasoline or wind electric plant, the desire for electricity on the farm is active indeed. But in considering the possible extent of total support for a farm electrification programme, the question arises as to the attitude of farmers with private plants when central station power becomes available. Does the farmer with his own electric plant want central station electricity? Is he satisfied with his own plant? These and similar questions were raised by the Commission in its studies of the R.E.A. Throughout Minnesota and among the officials at headquarters of the R.E.A. in St. Louis, Missouri, the answer was the same. "When electricity from a high tension line becomes available in a community, the farmers with their own electric plants are the first to sign up for the new service." A ready explanation for this phenomenon is that these are the very farmers who have experienced the advantages that are to be found in the use of electricity on the farm. In many cases they become dissatisfied with the limitations on the use of power that are associated with the gasoline or wind electric plant and with the high cost per kwhr.

Not content with the verbal statements of officials in the United States, this Commission submitted a brief questionnaire to each of fifty-four electric co-operatives in Minnesota and to six co-operatives in North Dakota. Among the questions asked were the following:

1. What percentage of farmers within 1,000 feet of existing lines who had their own wind electric chargers signed up for R.E.A. service?

2. What percentage of farmers within 1,000 feet of existing lines who had their own gasoline electric chargers signed up for R.E.A. service?

Replies to these questions were obtained from all but one of the co-operatives in North Dakota and from 21 co-operatives in Minnesota. The complete results are shown in the following tabulation:

Percentage Signing Up for Energy	*No. of Co-operatives Reporting Where Farmers Had Wind Electric Plants*	*Gasoline Electric Plants*
100%	10	3
90 to 99.9%	9	14
80 to 89.9%	2	1
70 to 79.9%	2	2
Less than 70%	3	1
Total	26	26

These figures show that in the experience of ten co-operatives all farmers with wind electric plants who were within 1,000 feet of existing power lines signed up for R.E.A. service. Eight co-operatives reported that all farmers in their territories were prepared to abandon their private gasoline electric plants when central station service became available. In the experience of only three co-operatives was it true that less than 70% of farmers with their

own wind electric plants signed up for energy. As for those farmers possessing gasoline plants, in the case of only one co-operative was it true that less than 70% signed up for energy.

The above figures support the view that the farmer with a private electric plant is no serious hindrance to the establishment of high customer density along the power line. A similar conclusion may be drawn from a study of the records obtained by this Commission as a result of the sample survey of Manitoba farms to which reference was made above. On all farms reporting the use of private electric plants, our investigators obtained detailed information with respect to original cost, operating cost, age and condition of the plants. The farmers were also asked to voice their opinion on the question of changing over to central station power if it were to become available. On the whole, it may be said that the majority of farmers with private plants are looking forward to the time when they can change over to central station service. Many are dissatisfied because they cannot use electricity from their plants for motors of any substantial size, for cooking, or for water heating.

Several farmers were inclined to make reservations on the grounds that to introduce central station power would probably mean rewiring the buildings, or that their plants were purchased recently and to sell them would mean a substantial loss. The reluctance of these farmers to change over from their own plants to central station service may be minimized as a result of at least two important factors. Experience in the United States has shown that in some instances the wiring used in connection with a private plant is adequate for standard utility voltage utilization. Moreover, the survey made by this Commission indicates that a large proportion of the plants now in use in the province are quite old. In the case of relatively new plants a fairly good resale market will exist in those areas which cannot be reached by central station power.

Tenant Farmers in a Farm Electrification Programme

There remains to be considered the problem of bringing power to farms operated by tenants. No matter how strong the desire for electricity on the part of the tenant may be, the final decision rests with the landlord. It is to be expected that landlords will be slower in signing up for energy for their tenants than if they were working the land themselves. This problem is an important one in Manitoba, since approximately one out of every five farms is operated by a tenant. Will this be a barrier to bringing power to Manitoba farms?

In the United States the tenant problem is not regarded as a serious stumbling-block to farm electrification of a given farm area, partly because the landlords see the advantage of having their tenants supplied with labour-saving and cost-reducing devices and services. More particularly, experience

indicates that the landlord is frequently compelled in his own interest to electrify his farm for the tenant. If he fails to do so he will tend to get an inferior type of tenant and thus sooner or later reduce the rental value of his farm.

In Minnesota and North Dakota, as may be seen from the accompanying figures, seven out of twenty-six co-operatives reported that from 90 to 100% of all tenants took electric service

Percentage Signing Up for Energy	*No. of Co-operatives Reporting*
90% or over	7
80 to 89.9%	7
70 to 79.9%	3
60 to 69.9%	3
50 to 59.9%	3
Less than 50%	3
Total	26

In two cases all tenants became members. In only three out of the twenty-six co-operatives for which data were secured, did less than half of the tenant farms become users of electric energy. If the experience in the United States is applicable to the situation in Manitoba, we may conclude that at least half, but probably more than half, of the tenant farms will become users. As previously pointed out, even though landlords may show some hesitation in spending the funds for wiring, with the passage of time they will be induced to act, otherwise they will have to be content with an inferior type of tenant and thus possibly lose more by not spending from $100 to $200 for wiring than by making this additional small investment.

Over a period of years the Manitoba Power Commission has received numerous letters from farm power users. A few of these recently received are reprinted herewith to show what Manitoba farmers have to say in their own words as to what power means to them.

Dear Sir

When a farmer in the thick of harvest sits down to write a letter you may wonder what is wrong with him anyway. Well, maybe I am going a little sentimental about electric light and power on the farm, its convenience and economic value, but I feel that I simply must tell you about it with the hope that more farmers be induced to avail themselves of Rural Electrification of their homes and buildings. In short this will be a Song of Praise for Manitoba Power, especially as it affects the farm homes.

We took on the current last fall. I had my place wired for light and power, house, barns, granary, but dreaded the initial cost of installation, etc., not knowing what its actual saving could amount to.

Well, it may interest you to know that for the first time in years we had trouble finding a maid to help the wife with the housework, etc., because of labor shortage. My wife claimed that she could manage if I would get an electric washing machine, which I did. This enabled us to get by for seven months without help in the house, and wages and board saved more than pays for the machine and current used. I must explain that I have two daughters of school age who help a lot but could not assist on wash days.

We have since bought a frigidaire and hot plate to ease the worry of feeding the family or hired help, and really it's grand and saves food as well as keeps it more palatable. We are indeed most happy about the conveniences as well as the actual dollar and cents savings effected.

Last January I had ten sows coming in with their litters. I have had winter litters for the last dozen years and always had trouble because of the cold, losses were huge. I put up stoves in my hog house but most of the heat went up to the ceiling, and down on the floors of the pens it remained cold and damp. Last winter I used an electric brooder lamp and I cannot speak too highly of its efficiency. I could direct the rays onto the sow in the pen, the bedding was dry and warm and I saved practically all my young pigs. When I figure this amount in actual dollars saved it would pay for the whole outlay of installation.

Furthermore, with the barns well lit the chores and feeding were half the work. I could go on telling you about dozens of cases where electricity on my farm has saved labor and money. Next time you are in this part of the province would appreciate if you would call in and I would demonstrate what rural electrification can do.

Yours sincerely,
J. J. Siemens,
Altona, Man.

Dear Sir

As a user of electricity on the farm, I would like to give you an idea of just what it does and saves for us (if such estimate be possible). When we thought just of having electricity in our home, the foremost thought to us was the convenience and safety of our lighting system over the old coal oil. Fine as that is, it seems to be a small part of the service.

By its use now, we pump water, drive a three-unit milking machine for 30 cows or more, skim our milk, wash milk and cream bottles for the dairy, run the grain cleaners and machinery in the work shop. In the house our electric range, washing machine, iron and last but not least, our refrigerator (something we scarcely know the value of in any kind of weather). A service from day to day, year in and year out, rendered without a kick. Time and labour saved we can scarcely estimate.

Yours very truly,
T. J. Wilton and Family,
Roland, Man.

Dear Sir

Being the proprietor of a dairy farm and using hydro power, I economize as much as possible. Having gasoline motors formerly, however, cost me more

A great deal of time was lost in doing without these motors, especially in winter time What a benefit it is to have good light for milking the cows, which is such an important thing in the maintenance of cows. A person couldn't enumerate all the services that hydro makes possible.

One could say that electricity on the farm saves even the salary of a hired man

Would you believe that with electricity on a farm you can have a radio, electric guitar with an amplifier, as well as high powered microphone, a vacuum cleaner, an iron, a washing machine, electric stove, etc

The neighbors who haven't electricity enjoy the radio programs almost as much as we do, through the medium of this microphone, and the loud speaker that we installed in the yard.

I must not forget to mention my electric razor with which shaving takes me only three or four minutes each morning Then, too, my wife is always in a good humor!

What an advantage it is for us to have hydro on this farm!

J. O. Lavoie,
LeSeigneurie,
St Boniface, Man.

Dear Sir

A brief letter telling you how the hydro is appreciated on the farm I have a milking machine that milks an average of 19 cows a day that saves at least three hours work a day, giving us more time to do more work and better work on the farm, while the wife does the milking with another girl

About the frigidaire that we have you lose absolutely no food and save thousands of steps compared with the old way running up and down the cellar

About the toaster, the toast is made while we are eating, saves time, and in the hot days we have a hot plate stove which is very much appreciated

About electric shaver, well while I am shaving my wife cuts my hair And for keeping nice clean cows, talk about our electric clipper, you easily clip 30 cows a day

It is no more a blue Monday for my wife doing the washing and ironing by electricity There is good light all over the house and in the yard with hydro, no lamps or lanterns to look after

My wife's doing the housecleaning with a vacuum is a relief not only for cleanliness but is sanitary In as far as I am concerned nobody will do all that is done by electricity for less than $125 dollars a month.

We certainly owe a great thank to Mr. McLeod, who keeps everything in first class order in Lorette district

I am yours,
Louis J Marcoux,
Lorette, Man

Dear Sir

We have been connected up with your system now for some sixteen years At first we had a single phase hookup which was quite satisfactory as far as it went Later we felt that we required more service, so about four years later we had a three phase hookup installed.

We have since kept adding as our requirements demanded Now we are fairly complete, including range, refrigerator, running water washing machine, etc Outside, besides pumping units, we have a fifteen horsepower motor to do the heavy work, such as grinding. Along with our farming operations we operate a cleaning plant We contract quite a large acreage of peas and these we prepare and grade, etc., for market We estimate that we will handle through this plant at least twenty-five carloads besides considerable other grains.

I can state quite frankly that were it not for having plenty of power, reasonably priced, our operations would be considerably hamstrung I am not in a position to give the relative costs as per gasoline power, but can state quite definitely that electric power is much more economical and by far more convenient and satisfactory in every way

I can truthfully say that I never want to farm again as it was before. Apart from the monetary value, the comfort and satisfaction we have make life much more worthwhile. Electricity on the farm makes many of the better things in life within reach

Yours very truly,
Thos. Sanderson,
Portage la Prairie, Man.

DRINKING FOUNTAINS CAN BE KEPT FILLED BY ELECTRIC PUMPS

Dear Sir

Having had the benefit of hydro light and power for almost sixteen years, would like to state some of the uses and advantages we get from electric energy over the old style gas engine and kerosene lamps

We grow annually about 60,000 lbs. of garden seed for the seed department of a large retail store, comprising three varieties of garden peas, three varieties of garden beans, soy beans, sweet corn, gladiola bulbs, and peony roots, in all of which we use electric power and light in handling

The peas, beans and corn all have to go through a cleaner driven by a 3/4 H P electric motor After that the seed goes over a hand picker driven by a 1/4 H P motor with electric light and reflector over the picking table The power for both operations is much smoother and quieter than that of a gas engine and can be started and stopped by simply turning a button To help in drying gladiol bulbs and sweet corn seed we use a 1/4 H P motor attached to a large fan

The house is fully modern thanks to hydro, having automatic water pressure, hot and cold, also sewerage system, bath and all other electric equipment, such as electric range, refrigerator heater, toaster, iron, fan, electrolux pads and radio, with plenty of lamps all over the house

Our yard is well lighted by turning a switch at the house. three yard lights make the yard as light as day and can be turned off or on from the barn as well Much superior to the old style lantern on a dark stormy night and much safer.

Yours for more power in the future.

The Peony Farm,
Portage la Prairie, Man.

Dear Sir.

I wish to express my appreciation for the splendid service you give us rural hydro users. Here on the farm the hydro brings us nearer the city it also makes it easier to secure help and lessens the fire hazard. We use the hydro for the following duties on the farm Besides the lights we pump the water and clean the grain, also use light bulbs to heat the brooder for the young chickens

We use a small rotary pump to irrigate our garden and lawn. This water is pumped up from the ravine Then in the house we have the electric range, frigidaire, power washer, power ironer My wife can sit on a chair and do the week's ironing in a few hours We have a Mixmaster, water heater, radio, electric fans, etc I forgot to mention that we have a shower fixed up in trees and with water pumped from the ravine during the summer months we have a shower every evening

Our main business is bee-keeping and this is where the hydro has saved us a lot of money We make all our supers, lids, bottom boards, frames, etc., on our machines which are powered with an electric motor We have saved several hundred dollars by doing all this work ourselves.

In the honey house we have a power-driven extractor, also an electric uncapping plane, electric heated honey tank, electric hotplates which heat the water for jar washing, also a Mixmaster with which we produce our whipped honey in glass, With all these electric conveniences it enables us to turn out 500 lbs honey daily in glass jars besides a the honey we put in tins Then we have an electric heated insulated room in which we keep our honey in combs all winter This heat is controlled with a thermostat, also in the cellar where we keep the bees in winter, if it is too cold we heat with the electric heaters and if too warm we cool with fans.

In closing may say that the hydro was the best investment we ever took on and it will be a splendid thing for the farmers in general when the hydro is in all the homes on the farms.

Yours very truly
Roy Mullin,
Myrtle, Man.

Dear Sir

Just a few words to tell you what hydro means to me it saves time and labour by making, pumping, washing and other farm jobs Besides providing lights there are all the modern conveniences to make farm people more contented, all of which helps them to do their work more efficiently, especially in these days when men are no more available and production must be kept at a maximum.

In my case, if electric power should be curtailed or cut out, it would not only mean extra work, but would also reduce my milking herd considerably

Knowing the advantages that can be gained by using hydro, I believe it should be made available to as many farms as possible

Yours truly.
Jos. Grossman.
Lorette, Man

Dear Sir

I have had hydro service on my farm for three and a half years now and have found it a great convenience. The appliances in the house and the lights in the outbuildings make our work easier and quicker I have a poultry flock of around 500 hens and lighting has certainly increased production. In our farm work shop we are now able to do little grinding jobs, etc., by use of a small motor, which we were not able to do before

Yours sincerely,
C. P Wohlgemuth.
Steinbach, Man

Dear Sir

I would like to tell you what hydro service has meant to me Besides the convenience possible in the home I have put in a milking machine and pump in my barn. I had to do this on account of the labor shortage. I have 24 head of cattle and I ship milk I save one man's labor Due to hydro service I figure I save $500.00 a year

Hoping many farmers can have these advantages

Yours truly,
L. D Marcoux.
Lorette, Man

Dear Sir

Having only put in hydro in December, 1941, I have not derived all the benefits I expect to However, I have had increased production from my poultry flock—between 300 and 400 I used a small motor on my fanning mill for cleaning grain and saved a man's labour there The convenience of having the lights in the barn and outbuildings has been a great help.

Yours truly,
M F Barkman,
Steinbach, Man

Dear Sir

I would like to mention the difference having hydro service on the farm has meant to us We have an electric range, refrigerator, hot water heater radio washing machine and we have on the farm all the advantages of town life Our buildings are all wired.

Previous to hydro service we had a gas motor on our pump and milking machine Changing to electric motor we had considerably cheaper and trouble-free operation

Yours truly,
Mrs. G. Berri
Dufresne, Man.

Dear Sir

A year ago this fall we installed a 16-ft elevator in the granary It is operated by a ½-horse-power motor This has proved to be one of the best labour-saving devices we have. We can elevate grain to any bin and no one has to go into a hot dusty bin to shovel back grain Not only in threshing time, when help and time is at a premium, but any time we can elevate grain to any other bin.

In the house about five years ago we installed an 18-gallon hot water tank Water is ready any morning for washing. No lugging water to a stove to heat and water is always ready for dishwashing and the many uses for which hot water is necessary In canning time especially, the tank saves both time and energy as the water in the tank is hot—ready for processing either fruit or vegetables.

We have had the hydro since 1925 and wouldn't like to do without it It surely takes a lot of the drudgery out of farm work

Ever a satisfied customer, I am,
Yours truly
R. C. Stocks,
Myrtle, Man

CHAPTER VIII

PROMOTING THE USE OF ELECTRICITY ON THE FARM

Why Promotion is Essential

"The wheel, an invention of relatively recent origin, was discovered only once and knowledge of its use spread by slow diffusion all over the world." This startling assertion might be regarded as the motif of this chapter. It is not enough to bring a power line along the highway and wire the farm buildings. In the United States an extraordinarily ambitious programme of education directed toward greater load building and power using has been under way for twenty years. The same is true in many other parts of the world. S. E. Britton of the Chester Electricity Department of Great Britain states:

> For electrification on the farm to bring about the most economic conditions it is necessary to build up the demand for the uses of electricity faster than seems possible by the recognized methods applied to urban areas, namely advertising, circularizing, canvassing, and showrooms. In addition there should be available a competent technical and practical staff to deal with engineering and commercial matters, both as regards the requirements of the undertaking and the consumers.[1]

Reverting to our reference to the invention of the wheel, even the American Indian, when wishing to transport goods, relied upon the travois, consisting of two poles fastened together a few feet apart. Lifting one end of the poles, he laboriously dragged his cargo across the ground. The wheel is an invention of such ordinary and universal use that we are inclined to take it for granted. Yet students of anthropology tell us their researches suggest that this great labour-saving device was hit upon only once in the history of civilization. As one group of primitive people using it came into contact with another group not yet having knowledge of it, its use was spread by an exceedingly slow process of diffusion. Apparently it took thousands, perhaps hundreds of thousands, of years for this invention to become the common property of all peoples. Most inventions occur only once and spread all over the world.

Of course primitive peoples had no written language, no radio, and only slow means of communication, so that the analogy between the wheel and the use of electricity on the farm is not a perfect one, yet it should suggest to us that if farmers are to secure the maximum use from electric power from the standpoint of both improving their economic position and of improving living conditions on the farm, a positive educational programme must be undertaken. Furthermore, electric energy is a mysterious and intangible force, requiring much study if its nature and potentialities are to be understood.

[1] Third World Power Conference, Washington, D.C., 1936, p. 900.

Yet the anthropologist or sociologist has another lesson to teach us. Television, the broadcast of moving pictures through space, was discovered in the middle of the 1920's by five or more different persons independently of each other. The expert explains this event in this way. Once knowledge or an art is developed to a certain stage (radio in this case) and its development is widely known and understood, many researchers or inventors working simultaneously but independently will hit upon the next stage of development at about the same time. In order for this to take place, it is necessary for students of the subject to have knowledge and understanding of the developments up to the present stage. Then the next logical inventive step follows almost inevitably.

Thus if farmers are to make the widest possible use of electric power, an educational programme is essential to bring them information about developments to date and to make available to them the apparatus, appliances, and whatever else is necessary to hasten the process of diffusion. Furthermore, as this knowledge is brought to them, we may expect that more and more uses for electricity on the farm will be invented, on the farm as well as in the laboratory. In many cases such inventions will take place simultaneously, as with television, in many parts of the province, the country and the world.

Apart from the foregoing argument, there is a further reason why the promotion of the use of electricity is more important than is the case with most other services and commodities. This relates to the financial structure of farm electrification and the nature of electricity supply.

An examination of the expenses in running a farm electrification business in Manitoba shows that most of the expenses are largely independent of the amount of energy consumed. Given a system of farm lines, transformers, meters and other apparatus, the total annual expense per farm increases less than 10% when the average consumption increases 100%.[1]

To be sure some costs vary with output. The more energy sold, the more will it be necessary to pay for power at the source of supply. The more customers, the higher will be the total meter-reading and billing cost. A great many of the other costs, however, remain entirely fixed or rise less than proportionately with an increase in sales and consumption.

Thus the interest on investment has to be paid whether business is good or bad. The sinking fund contributions are fixed regardless of volume of business. The depreciation of plant and equipment goes on in about the same degree whether much or little use is made of it, just as one's house depreciates with the mere passage of time, even if one does not live in it. Similarly, a part of the generation, transmission, and general administrative costs is

[1] As we shall see in Chapter IX, Tables 26 and 29, this is one of the reasons for the block rate system, under which the customer pays a progressively lower rate the more power he uses per month.

the same regardless of the volume of business. To be sure, should the business grow by a large percentage, many of these costs which are fixed in the short run would rise precipitously, until they became constant again on the basis of the new enlarged investment demanded by increased volume.

The significant conclusion to be drawn from this analysis is this: It is in the interest of the farmer to promote high saturation of customers along the line and a high saturation of energy using appliances, because, within limits, every increment of use comes a little cheaper. That is, so long as there is a fixed plant, every increase in output and sales will not be accompanied by as large an increase in expense. Even if the expanded sales call for an enlarged plant and more equipment, the rise in consumption to this new level would not be attended by a proportionate increase of these overhead or fixed costs. Expanded usage should mean steadily lower rates and more cultural and economic benefits for the farmer and other users as well.

Who Should Undertake Promotion?

Everyone in a position of leadership and interested in the progress of the farmer and the welfare of the entire Manitoba economy should take a hand in the promotion of the use of electric power upon the farm. This promotional work naturally falls into two categories: (1) fundamental research in the application of electric power to the solution of Manitoba farm-operating problems, and (2) educational work to promote knowledge among the farmers of what power will do for them.

Some agencies within the province or the country will be interested in both of the above aspects, others will be interested in only one or the other. Manufacturers of apparatus and appliances will be interested in the development of equipment which is adapted to Manitoba conditions. For example, because of the (1) cold, (2) long winters with a relatively (3) short daylight period, every effort should be made to develop appliances at reasonable prices which will overcome these three handicaps as they affect farm operations. Likewise the University of Manitoba and other public schools interested in agricultural education might concern themselves with this problem, as well as with the promotion of knowledge among the farmers of the potentialities of power on the farm.

Research and Educational Efforts in the United States

We have already seen that by 1942 nearly two out of every five farmers in the United States had central station electric power. This achievement is in no small measure due to the efforts twenty years ago of a small group of interested parties and later to a large number of persons and organizations in industry, farm organizations, educational institutions, and governmental bodies. So many persons and organizations contributed to this effort in the 1920's that we hesitate to mention any of them for fear of slighting hundreds

of others. The following brief outline must be regarded only as an indication of the dynamic energy and far-seeing planning which constitute the background of present development.[3]

The National Electric Light Association (N.E.L.A.)[4] and the American Farm Bureau Federation agreed in March, 1923, to take the lead in organizing a national body to co-ordinate the activities of all groups interested in farm electrification. In the same year the plan was put on a working basis through the formation of the Committee on the Relation of Electricity to Agriculture (C.R.E.A.). Of the committee's twelve members three were officers of the American Farm Bureau Federation, four represented the N.E.L.A., and one each came from the American Society of Agricultural Engineers, the manufacturers of farm electric plants, and the Departments of Agriculture, Commerce, and Interior of the United States Government. Groups which joined later included the National Grange, American Home Economics Association, Association of Farm Equipment Manufacturers, and National Electrical Manufacturers Association.

Under this leadership twenty-seven state committees were established to initiate and help finance (mainly from funds contributed by electric light and power companies) the actual work of research and experiment. Most of the laboratory tests were carried out by state schools of agriculture at their experiment stations. Every known use of electricity on the farm was carefully re-examined and many new uses were developed, exhaustive tests of applicability were made and comparative cost data were assembled. The results were reported to the national committee, which accumulated and published them in a series of bulletins and news letters.

The experiments were not allowed to end in laboratory records, however. Application of the research findings to actual farming was an integral part of the programme from the beginning. In each of seven states a rural distribution line serving a typical farming community was selected or built as a test project. The state C.R.E.A.s, utility companies, agricultural schools, equipment manufacturers, and farmers collaborated to establish these test projects and operate them under controlled conditions. The records of the test projects and other experiments, conducted under C.R.E.A. sponsorship by agricultural engineers, were, at least until recently, the most complete and dependable body of data on the use of electric power on the farm.

The first state project, and probably the best known, was the one established by the Minnesota C.R.E.A. in the Burnside community near the town of Red Wing.[5] The distribution line, 6.3 miles long, was built by the

[3]The material was gathered chiefly from the following: Harry Slattery, *Rural America Lights Up*, 1940; David C. Coyle, *Electric Power on the Farm*, 1936, and Raydon Stewart, *Rural Electrification in the United States*, Edison Electric Institute Bulletin, Sept. and Oct., 1941.

[4]Now called the Edison Electric Institute, New York.

[5]The report on this project and many other bulletins have been turned over to the Provincial Librarian, Legislative Building, Winnipeg.

Northern States Power Company of Minneapolis to serve nineteen prospective rural consumers, of whom sixteen eventually were connected. Service began in December, 1923.

Seventy-nine manufacturers of electrical farm equipment co-operated with the farmers, eight of whom took part in the controlled tests, the utility company, the C. R. E. A., and the University of Minnesota in financing the tests. To June 1, 1929, a total of $75,136 was expended on the project, including equipment worth $21,632 lent by the manufacturers, $9,574 contributed by the University, and $17,500 by the C. R. E. A.

The Red Wing test was concluded in 1929. In addition to the carefully collated records of individual applications, complete operating data for five of the farms were reported for the years 1924-27, inclusive. From these the project directors were able to draw certain fairly definite conclusions as to the economics of "total" farm electrification under the conditions obtaining in one kind of farm community.

Some conception of the extent of this activity may be gained from the report on farm electrification research published in 1931 in the C. R. E. A. Bulletin, Vol. VI., No. 1. It said in part:

> This survey of research, although including only a part of the active agencies, has brought to light 211 investigations connected with or stimulated by the Committee on the Relation of Electricity to Agriculture, 693 active projects in colleges, universities and the United States Department of Agriculture related to rural electrification, 118 undertakings of an investigational nature by utilities and commercial concerns, and 30 investigations in private and other laboratories. Eighty-five suggestions for new studies have also been received.
>
> Twenty-eight state experiment stations and a number of private laboratories, power companies, and farms were visited in making the survey.
>
> Magazines, journals of professional societies, chemical and biophysical abstracts and the Experiment Station records furnish an unending succession of references or at least clews indicating the location and progress of related investigations. Time has permitted the examination of only a limited number of these.

The results of these investigations were made available through hundreds of publications issued by the associated groups in addition to the C. R. E. A. bulletins and news letters. No. 1, Vol. I of the Bulletin listed 227 uses for electricity on the farm and 190 uses in rural districts. The extension services of the agricultural colleges and the departments of agriculture, women's clubs, farm organizations, and the rural service departments of power companies further aided in making the benefits of electricity known to the farm men and women over the nation. The N. E. L. A. estimated in 1931 that one thousand employees of power companies were devoting part or full time to extending electric service into the country and developing the load on existing lines. Many of those rural service representatives were trained in the rural electric short courses given by the agricultural colleges with C. R. E. A. co-operation.

While some work preceded that of the C. R. E. A., the foregoing outline gives a brief summary of the efforts put forward in the 1920's in the application of electricity to farm operations.

University and Agricultural Colleges

Reference has already been made to the contribution to rural electrification made by the universities and the state colleges of agriculture in the United States. Nearly every major institution of the foregoing kind has carried on research and promotional activities in this connection since at least the middle 1920's. Reference to the University of Minnesota has already been made. At the present time at the University of Minnesota Dr. Andrew Hustrulid of the Division of Agricultural Engineering is engaged in the study of farm refrigeration work in the Division of Horticulture, studying the effect of varying temperatures from 5° F. to 45° F. on appearance and palatability of fruits and vegetables. Several experimental freezing units have been designed and various factors of the design are now being studied. This is only one illustration of what is done at this institution.

Iowa State College has long been interested in helping farmers with their rural electrification problems. Numerous university departments at present co-operate in the work. Early in the study the National Electric Light Association, the state farm bureau, manufacturing companies, and public utilities co-operated in the projects. A study of the characteristics of rural distribution lines in the use of electricity on the farm was made in co-operation with a group of farmers at Garner, Iowa. A series of bulletins was published as a result of this three-year study. These bulletins were regarded as among the most authoritative sources of information on rural electrification.

The Extension Service at Iowa State College has assisted farm groups in securing electricity by supplying them with information as to what is required in forming a co-operative, cost of service, number of members required, how to wire farm buildings, and how to select and use technical equipment on farms. Conferences and short courses were held at the college to train the field personnel of R.E.A. co-operatives.

The National Farm Equipment Electrification Show began as a result of the interest Iowa co-operative managers manifested in a short course held at the college in 1938. The show was put on in Iowa during the fall of 1938 and was so successful that it was enlarged and made a national show conducted by the R.E.A. staff. All types of farm and home equipment were shown and demonstrated.

The Extension Service specialists have held a large number of meetings and demonstrations with farm groups, supplying them with information on the proper methods of wiring and lighting. Special bulletins have been prepared and used as supporting literature. Over 30,000 bulletins dealing with electrical wiring for farm buildings have been distributed to farm people. Meetings on farm water systems with demonstration installations were common. About 20,000 copies of a bulletin entitled *Electric Motors for the Farm* were distributed in the first year of its publication. This has been used as a basis for discussion in numerous extension meetings and has also been widely

used by vocational education departments and science departments in the Iowa high school system. Numerous mimeographed leaflets were also prepared and used as supporting material at meetings and for answering the large volume of correspondence received by the college.

Among other things, the College of Agriculture of Ohio State University began a monthly bulletin early in 1939, each bulletin covering some specific phase of electric service. These are made available to private utility companies and the R.E.A. co-operatives at the cost of printing. These bulletins consist of a single page, showing a photograph of some technical appliance in use on the farm, with a brief description of what the appliance can do, what its capacity may be, what it costs to operate, and other relevant material. As evidence of the contribution made by Ohio State University, the following list of single-page bulletins published since 1939 is included:

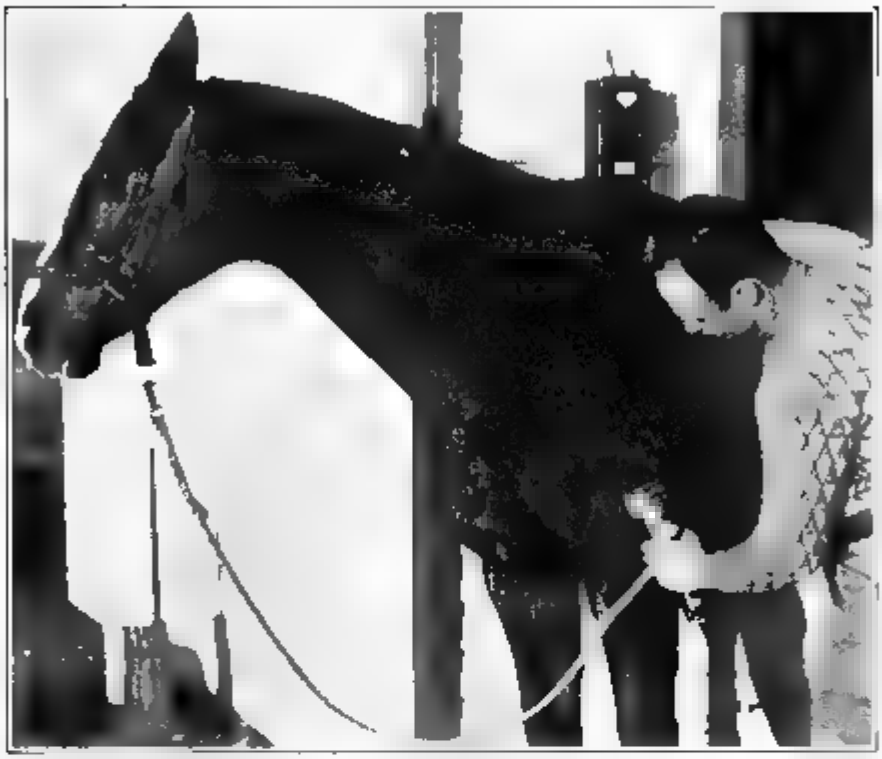
Electric Fences
The Electric Range
Small Electric Motors
Lights for Winter Eggs
Electrically Operated Feed Grinders
Rules for Good Lighting
An After-Christmas Story for Your Home
Electric Brooders
The Electric Ironer
Electric Milking Machines
Electric Water Heaters
Electric Milk Coolers
The Electric Roaster
The Electric "Hot Plate"
Electric Power for Silo Filling
The Electric Mixer
Portable Electric Motors
The Electric Washing Machine
Care of Electric Motors
Running Water a Farm Necessity
A Refrigerator for the Farm Home
Stock Tank Water Warmers
Keeping Electricity Safe
The Electric Vacuum Cleaner
Electric Pig Brooder
Electricity in the Farm Shop
Electric Cords
Electric Dairy Water Heaters
Care of the Vacuum Cleaner
Sun Lamps for Poultry
Using the Electric Range
Electrically Driven Feed Mixers
Electric Water Warmers for Poultry
Use of the Vacuum Cleaner
Electric Hotbeds
Care of the Refrigerator
Electric Hay Hoists
Care of the Electric Range
Use and Care of the Electric Toaster and the Electric Hot Plate

Many of the bulletins prepared by agricultural colleges and universities are of a technical or semi-technical nature. For example, Kansas State College at Manhattan has made numerous scientific studies, reporting them in carefully prepared bulletins, such as *Milk Cooling on Kansas Farms*, *Hotbeds for Kansas*, etc.

From this brief survey, which is not in any way exhaustive, but is merely illustrative of what has been done, it should be clear that the University of Manitoba and possibly other schools above the secondary level may play a great role in the postwar period in the promotion of farm electrification through the facilities available to these institutions. Much work has been done elsewhere, but the question of electricity as adapted to the special conditions on Manitoba farms remains to be treated.

Secondary Schools and Farm Electrification

This Commission claims no special competence in the organization of or curriculum for the secondary schools. We wish to point out, however, that in the United States special efforts are made in the rural areas to provide



Electric Clippers Help to Keep Horses and Stock in Good Condition

some instruction in the application of electricity to the solution of farm problems Whether as part of the regular curriculum or not, it is possible to adapt a course in physics, for example, and especially that part of the physics course dealing with electricity, to farm electrification problems In many instances children are encouraged to write essays on the use of appliances in the home and in the farm buildings Regional or state-wide contests are held and prizes awarded during local or state fairs or at other suitable times.

If such a programme of curricular or extra-curricular activities is to be encouraged, it becomes necessary, of course, to have a teaching personnel not only competent in the principles of the subject but also with some knowledge of farm operations and particularly the problems encountered on the farm

Robert England, a careful student of education, states

> Thoughtful students are now beginning to realize that the herding of children into the classroom and the making of a gap between the so-called practical knowledge the child gains in his environment of farm and community and the literary education he receives in the classroom is a sin against the true spirit of culture [6]

[6] *The Colonization of Western Canada*. p. 184

Again Mr England makes the following remarks

> The rural school staffed by country minded teachers should be the natural ally in any campaign of improvement in maintenance of standards and in the dissemination or collection of information But it will be agreed that as an institution it has not been a marked force in agricultural development Its heavy task has been to create a literate population and to provide a limited number of candidates for higher education The narrow gateway of our high school and university entrance examinations has restricted the curriculum and methods of the rural school and given it an urban bias which, perhaps, is a reflection of the demands of parents not quite reconciled to the surrender of their children to an occupation toilsome and hazardous.[7]

This Commission wishes to emphasize that it has no desire to see electricity on the farm overemphasized in the curriculum of rural schools and it has no desire to bring about changes in policies which are regarded as unsound by those who have greater competence in this field than do the Commissioners All we are attempting to do is to point out that in our opinion the school curriculum in the rural areas might be reviewed in the light of the postwar development of farm electrification in the Province of Manitoba

The Minister of Education conducts numerous summer classes in rural areas in home economics and domestic arts. The role of electricity in the farm home might well become a feature of these courses

Provincial Department of Agriculture

Obviously the provincial Department of Agriculture has a role to play in this research and educational work The Women's Division of the Extension Service could help in the redesign of kitchens with a view to a greater use of electricity and in the promotion of better methods of preparing and preserving food Specialists now employed by the department concerned with field crops, livestock horticulture poultry, bee-keeping, agricultural engineering, and other specialties should all become thoroughly familiar with the uses and possibilities of electricity on the farm and bring this knowledge to bear upon the solution of the problems in their respective fields of interest The field representatives, located in the several districts throughout the province, likewise will need to review their function in terms of electric power on the farm Consideration might be given to the wisdom of appointing one person whose entire time will be devoted for a few years in the postwar period to exploring the field mapping programmes of work, and co-ordinating all the activities of all other programmes in the broad fields of electricity on the farm, in order to give direction and impetus to the work Furthermore, the department should work closely with the Manitoba Power Commission in promoting rural electrification effectively.

Other Provincial Departments

Other departments, especially those of public works and of mines and natural resources, should be prepared to help in planning settlement on new lands, if any such are opened up. For example, the haphazard way in which the farmer in some areas has located his buildings on his land, far from the road and frequently not as near to the most appropriate of the two roads

[7] *The Colonization of Western Canada*, p. 165

bordering his property, raises needlessly the cost of telephone lines, power lines, and road maintenance, and increases unduly distances between farmers' abodes. The proper provincial authorities could do a great deal in the future to encourage the location of farm buildings with a view to minimizing such costs, if and when new settlements are opened up. If two farmers place their buildings opposite each other and near the road, the cost of the power line is reduced and a single transformer of slightly larger size can serve both farmers.

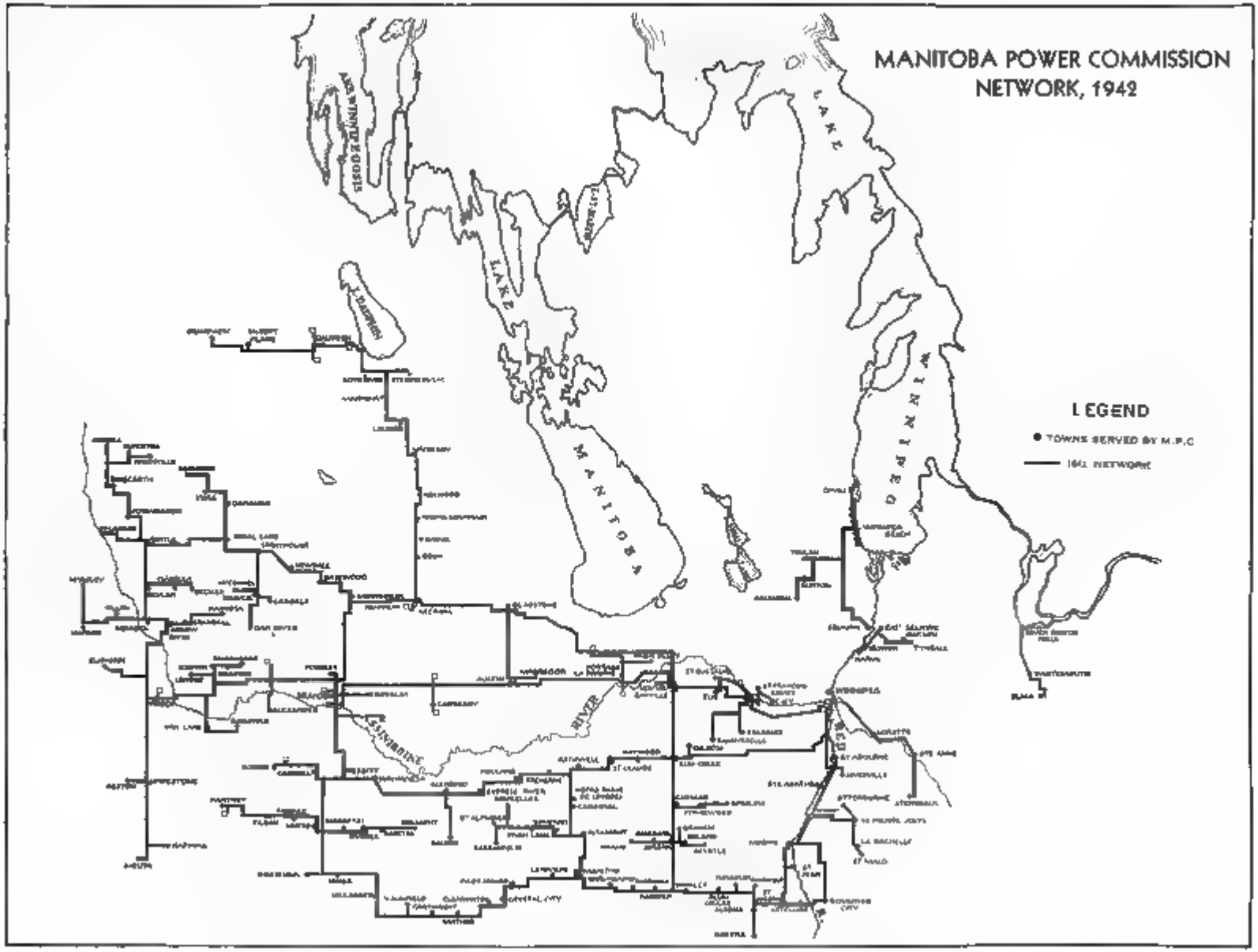
Furthermore, certain areas, for example in the interlake region, may be submarginal in terms of commercial agriculture. Some experts state that these areas should never have been opened to settlement. If a mistake has been made in this connection, a partial solution may be derived by shifting the economic activity of a given resident from sole reliance on fishing, or farming, or trapping, or whatever the resident's present activity may be, and instead encouraging more diversified type of activities under which the resident may be engaged in farming, fishing, trapping, forestry and the like each on a part time basis, depending upon the season. This might reduce the necessity of engaging in de-settlement activities and at the same time make it possible for the occupants to maintain an adequate standard of living. Obviously, the planning of power supply and the basic planning of resource utilization in such communities must go hand in hand in order to build up sufficient income to sustain the power lines.

Inter-Department Committee

Because of the numerous ramifications of farm electrification, talent and experience from all sources in the province should be brought to bear upon this problem. In the majority of the United States, as previously mentioned, special research and educational committees on the relation of electricity to agriculture were set up in the 1940's. These committees grew around the universities, public utility companies, electrical manufacturers, state departments of agriculture, and organizations of farmers.[6] Similarly in Manitoba such an over-all committee would be in a position to make a substantial contribution to farm electrification. Such a committee must be selected with great care in order to keep a proper balance between scientific research and educational work.

While emphasis on the comforts and conveniences of electricity upon the farm should not be neglected in order to make farming more acceptable as a way of life, the primary emphasis of most of these educational and research activities should be on "electro-economy", that is, labour-saving and cost-reducing activities must receive most attention in order that the entire economy may secure the benefit of an improved agriculture and so that Manitoba farmers may lead in the application of modern knowledge and equipment to the solution of their problems.

[6]President Sidney Smith has appointed a committee of experts from the University of Manitoba to serve the postwar farm electrification programme.



Manitoba Power Commission Network, 1942

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CHAPTER IX

FINANCING RURAL AND FARM ELECTRIFICATION IN MANITOBA

It would be difficult to find a more suitable foundation on which to build a programme of farm electrification than the network of power lines constituting the transmission and distribution properties of the Manitoba Power Commission. These properties are virtual electric links connecting towns, villages and hamlets throughout the province. Extensions to the existing power transmission system of the Manitoba Power Commission have already been planned for the first five-year period immediately following the termination of the war. Thus there will be provided a power arterial network[1] to which may be attached the thousands of miles of distribution circuits required for farm electrification.

Farm electrification, being thus closely bound up with the physical properties and operation of the Manitoba Power Commission, might well be considered the expansion of an already established rural electrification system. The proposed farm circuits would be the extremities of the rural power network, the service to farms in various parts of the province would extend from the rural lines already completed or from those which will be constructed in the initial postwar period. Since this favourable condition for the development of farm electrification is a factor of major importance, a short outline of the Manitoba Power Commission system becomes a necessary introduction.

Manitoba Power Commission System

In 1919 the Province of Manitoba established a power commission for the distribution of electric power throughout the part of the province not served by the City of Winnipeg Hydro Electric System and the Winnipeg Electric Company. To a great extent the competitive operations of these two corporations were confined to the sale of power in the densely populated urban area in and surrounding the City of Winnipeg. Until the year 1938 the power distributed by the Commission was purchased from the City of Winnipeg Hydro Electric System. Since the completion of the Seven Sisters power plant on the Winnipeg River in 1931, all power for rural distribution has been purchased from the Winnipeg Electric Company at delivery points adjacent to the City of Winnipeg.

In a period of twenty-three years the Commission's rural distribution system has grown from its initial area of supply in a small zone immediately west of Winnipeg to the present extensive network of 2,100 miles of power

[1] This network throughout the province is referred to, in this chapter, as "rural electrification" to distinguish it from farm electrification.

HARTNEY, MANITOBA—TYPICAL MANITOBA PRAIRIE TOWN

circuits serving 19,000 customers. Most of the towns outside the Greater Winnipeg area are now supplied with hydro-electric power, the principal exceptions being the towns of Dauphin, Neepawa, Swan River, Deloraine, Rivers, Roblin and Emerson. (The map on page 100 shows the location of power circuits of the Manitoba Power Commission.)

The total capitalization of the Commission on November 30, 1932, amounted to $5,060,966.91 and on November 30, 1936, to $5,535,894.05, all of which was advanced by the province. By November 30, 1941, the capitalization had increased to $7,771,943.49. Of this amount $7,279,637.53 was advanced by the province and $492,305.96 borrowed from the Commission's replacement fund.

The revenue of the Commission increased rapidly in the nine-year period from 1932 to 1941, indicating not only the continuous expansion of the area of supply but also an increasing utilization of electricity by the older towns on the system. Table 10 is a statement of the revenue received from all sources, including the gas and steam heating plants in the City of Brandon.

Comparable operating expenses for the same period show a less rapid growth and a change from an annual deficit of $9,541.00 to a surplus of $224,986.22 in spite of the fact that numerous rate reductions were made in this period. (See Table 11.) Attention is drawn to the fact that in 1941 the fixed charges were almost exactly 50% of the total annual expenses. Particular care has been taken to build up adequate reserves for all capital and operating

liabilities. These have increased from $691,404.98 in 1932 to $3,348,731.17 in 1941. (See Table 12.)

TABLE 10—REVENUES OF MANITOBA POWER COMMISSION

Revenue	1932	1936	1941
Operating revenue	$763,382 26	$825,469 89	$1,320,659 13
Water power bonus	75,406 05	106,970 29	128,592 82
Interest	3,257 86	29,513 31	52,877 60
Miscellaneous	1,666 65	3,166 81	26,374 07
	$844,219 85	$966,150 90	$1,536,303 72

TABLE 11 EXPENSES OF MANITOBA POWER COMMISSION

Expense	1932	1936	1941
Operating Expense	$425,235 96	$385,222 47	$ 658,953 56
Fixed charges	428,524 89	533,599 39	652,363 94
	$853,760 85	$918,821 86	$1,311,317 50

TABLE 12—RESERVES OF MANITOBA POWER COMMISSION

Reserve	1932	1936	1941
Capital reserves	$604,652 11	$1,472,107 46	$3,055,748 40
Rate stabilization reserve		22,000 00	174,000 00
Reserve for contingencies			82,282 73
Miscellaneous reserves	86,752 87	25,000 00	36,700 04
	$691,404 98	$1,519,107 46	$3,348,731 17

The extension of the rural electrification network since 1932 is well indicated by the figures found in Table 13. In this period the quantity of energy distributed increased 200%.

TABLE 13—GROWTH OF MANITOBA POWER COMMISSION SYSTEM

	1932	1936	1941
Communities served	61	95	151
Miles of line	1,038	1,355	2,002
Number of customers	10,871	12,106	18,479
Energy distributed	16,500,000 kwhr	21,900,000 kwhr	49,400,000 kwhr

MANITOBA POWER COMMISSION BONUS

The Manitoba Power Commission Act requires that all moneys received by the province since the first day of May, 1929, as rentals from lessees for water powers shall be paid into and form part of the consolidated fund, and the proceeds of such payments, after deducting the cost of administering such water powers, shall be credited to the Manitoba Power Commission extension account.

On the recommendation of the Commission, and with the approval of the lieutenant-governor-in-council, an amount may be withdrawn each year from the extension account sufficient to pay the interest and sinking fund charges on one-half of the capital cost of the properties required for generation and transmission of power to municipalities, farmers, or other persons. The distribution properties in the urban communities are not eligible for bonus.

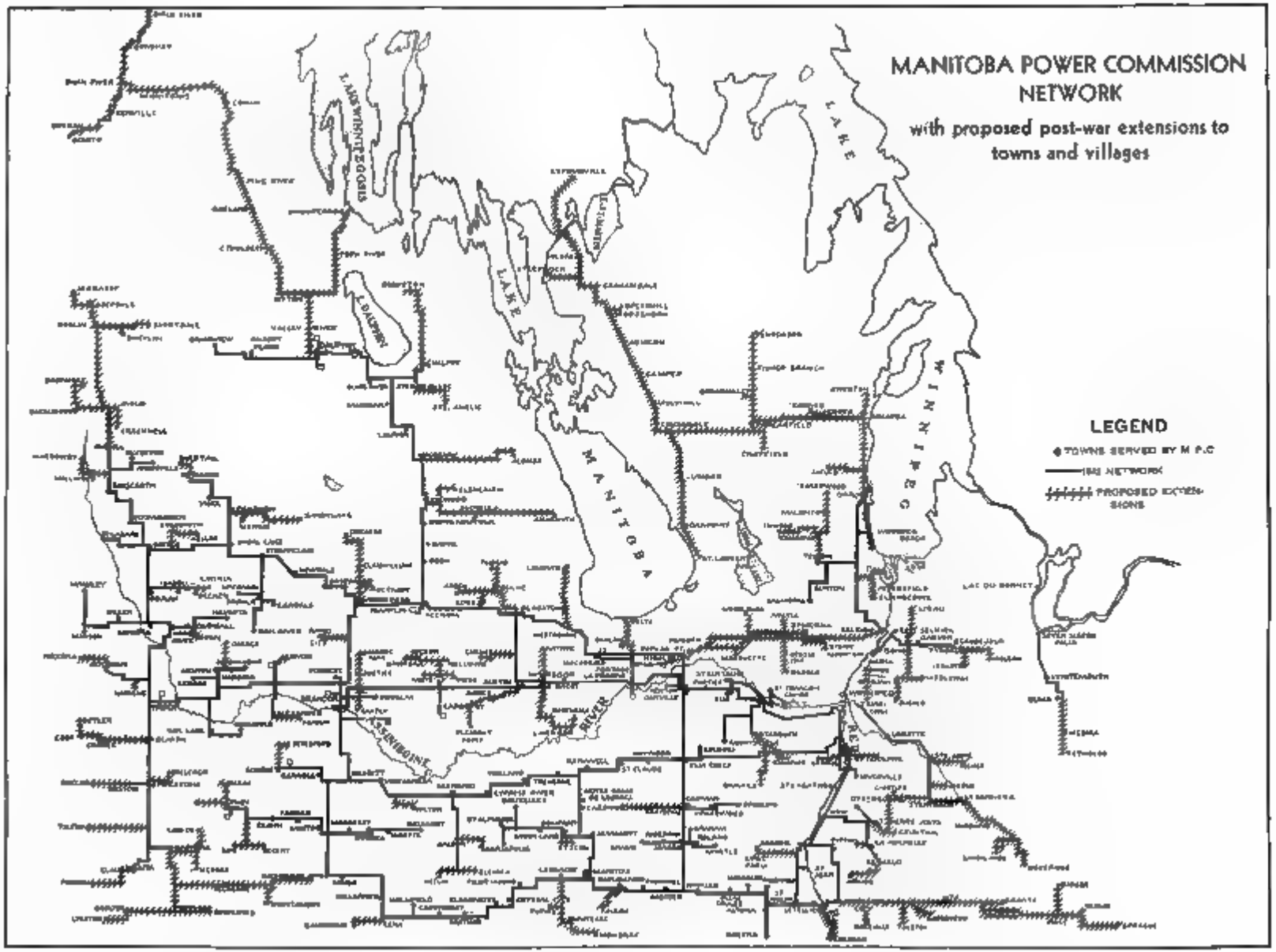
The water power rentals paid by the lessees of water power sites in Manitoba in the year 1942 amounted to $188,000. After deducting $25,000 for water power administration expenses, the remainder, $163,000, was placed in the Manitoba Power Commission extension account. This amount is $87,000 in excess of the Commission's bonus requirements for the year 1941. We may assume, therefore, that there are only sufficient water power rentals to provide the necessary bonus payments for an additional capital expenditure of $1,300,000 on rural transmission property.

For purposes of rough computation it may be assumed that the present bonus rate is 5.6% on one-half the capital, exclusive of the distribution properties in urban communities. A more convenient method of expression is 2.8% on the capital. (It will be noted later in this chapter, when dealing with the financial estimates for farm electrification, that a bonus percentage of 6.25% on one-half the capital, or 3.125% on the total capital, has been assumed.)

Manitoba Power Commission Personnel

The Commission is administered by three commissioners, the chairman acting as general manager and the other two commissioners giving part-time services and attending regular weekly meetings of the Commission. The system is operated by a staff of 150 employees, 126 employed by the electric utility and the remainder by the gas and steam heating utilities in the City of Brandon. Besides the main administrative office in Winnipeg and branch offices in Brandon and Portage la Prairie, there are secondary local administrations in 43 districts, each under a district supervisor. In addition to his responsibility for the maintenance and operation of the properties of the Commission, the district

Modern Manitoba Electrified Farm. Supplied by M.P.C.


MANITOBA POWER COMMISSION
NETWORK
with proposed post-war extensions to
towns and villages
LEGEND
TOWNS SERVED BY M.P.C.
M.P.C. NETWORK
PROPOSED EXTENSIONS
LAKE WINNIPEGOSIS
LAKE MANITOBA
LAKE WINNIPEG
WINNIPEG RIVER
RED RIVER
SOURIS

supervisor is required to act as the Commission's local commercial representative in his area. The supervisor's district varies in size from one to seven towns, according to population, and includes approximately fifty miles of transmission circuit. Having in mind the proposed postwar extensions, both for serving the remaining unserved towns and villages and for farm electrification, we call attention to the importance of an existing body of experienced district supervisors, knowing intimately the people and their problems, and quite capable of undertaking any additional responsibility which may be placed upon them.

Postwar Extensions to Towns and Villages

Many towns and villages in rural Manitoba have not yet received Power Commission service. Applications for service have been received from all parts of the province but extensions cannot be made until the end of the war. However, preliminary plans have been prepared for the electrification of most of the towns and villages that are within practical extension distance of the Commission's lines, and it is intended to proceed with the work as soon as materials can be obtained. The map on page 105 shows this proposed extended system.

Wherever possible, the initial expenditures will be confined to towns and villages which are now without electric service or which are not receiving service at rates comparable to those which can be offered by the Manitoba Power Commission. The plan conceives the ultimate possibility of making hydro-electric power available to communities of twenty persons and over throughout all parts of the province where agriculture is the dominant industry. This would include the acquisition of some or all of the existing plants and distribution properties in towns not yet supplied with hydro-electric power. The extent to which properties will be purchased cannot be predetermined. Nevertheless, it may be stated that the capital expenditure required for the Commission to supply and distribute hydro-electric power in towns and villages not now receiving it would lie between the following limits:

Modern Manitoba Electrified Farm Supplied by M.P.C.

To supply and distribute hydro-electric power in towns and villages, including the purchase of existing generating plants and distribution systems	$2,794,780
To supply and distribute as above, but eliminating all towns which have substantial generating plants and distribution systems of their own	$2,185,370

For the purpose of this report it will be assumed that only 50% of the rural generating plants and distribution systems included in the above total of $2,794,780 will be purchased, and that the actual capital expenditure for such purchases and the extension of the rural network will be the mean of the two estimates, or $2,500,000. It will also be assumed that the work will be carried out in a period of five years in five equal annual expenditures of $500,000. Estimates for this plan of rural electrification extensions are based on 1939 costs.

Manitoba Farm Electrification General Considerations

There are 58,686 farms in Manitoba. Of this number it is estimated that 53,000 lie within the service area in which it is practical to build farm lines and provide service at a uniform schedule of rates.[2] This does not necessarily mean that all farms within the service area are of a character which would justify the very considerable capital expenditure for service lines and equipment, but it gives, nevertheless, a basic number from which farm densities and average costs may be determined. The map on page 108 indicates the proposed farm electrification service area in Manitoba.

A survey of seven typical townships in Manitoba, carefully selected with the aid of the Department of Agriculture, established the fact that in the average township within the service area there are 67 farms which may be considered potential consumers. This survey was made by a special staff engaged by the Electrification Enquiry Commission (see end of chapter, Appendix C). A subsequent study of ten additional townships made by engineers of the Manitoba Power Commission confirmed the results obtained in the first survey.

In the determination of the average length of farm line throughout the service area a great variety of conditions were encountered. Manitoba Power Commission lines of various voltages and capacity exist in over 50% of the townships. This made it necessary to express the length of farm line required in terms of "equivalent" standard single-phase line and thus obtain a definite relation between the length of line and cost.

[2]Approximately 1,100 of these farms are already supplied with electric power. See Appendix C to this chapter.

Proposed Manitoba Farm Electrification Service Area, Tributary to Manitoba Power Commission Extended Network

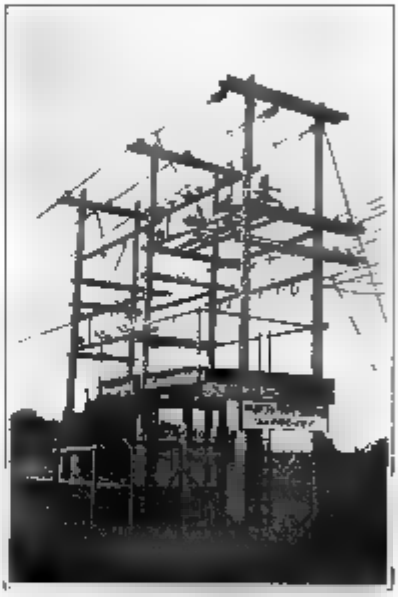
On the basis of the foregoing and estimating that on the average 80% of the farms in each township will be connected, the line requirements for each farm connected are as follows.

Length of line on road allowance	0 635 mi
Length of service tap-off	0 095 mi
	0 730 mi.

Based on an average of 60% of the farms in each township being connected, the requirements would be

Length of line on road allowance	0 755 mi.
Length of service tap-off	0 095 mi.
	0 850 mi.

It will be noted that the required length of line varies with the percentage of farms connected in each township. Throughout the report it has been assumed that except in special cases no local area will receive farm electrification service unless from the beginning at least 60% of the farms are connected to the system. It has been assumed also that during the first ten years of service in any particular area the percentage of farms connected will reach an average of 80%, in the better areas nearly 100% saturation should be reached. Attention is drawn to the fact that 16% more "equivalent" standard single-phase line is required per farm for 60% saturation than for 80% saturation. As capital investment must be kept at a minimum per farm service to maintain reasonable rates, too much importance cannot be attached to this phase of farm electrification.



Manitoba Power Commission Rural Substation

The Problem of the Tenant Farmer

The study of seven typical townships indicated that 20% of all farmers are tenants. The owners are insurance companies, mortgage companies, other institutions, and private individuals. The head offices of the institutions are often far removed from the farms, if a branch office is maintained, it is usually located in Winnipeg. Many private owners also reside in places outside the Province of Manitoba.

To these absentee-owners the farm represents an asset of uncertain value, and their interest lies in the return on the investment or the sale of

the property If farm electrification increased the income something might be done towards making electric service available to the tenant. This would require the owner to bear the cost of wiring the buildings and possibly the provision of some appliances such as motors. Experience indicates that the tenant will not bear any part of wiring costs owing to uncertainty of tenure.

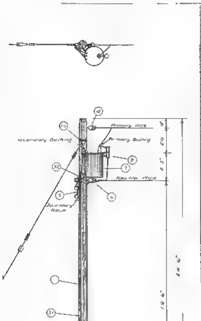
At the commencement of a programme of farm electrification tenant farmers undoubtedly will be a problem. With the passing of time this difficulty may be overcome and turn out to be an obstacle no greater than the tenant consumer in towns and villages. As soon as a high farm service saturation is attained, electric service will be considered indispensable by the prospective tenant and thus the pressure of demand will solve the problem. It is difficult to estimate how long it will be before 80% of tenant farms are serviced but it is likely to take at least ten years

Capital Cost of Manitoba Farm Electrification

The capital cost of serving farms in Manitoba will vary between an average of $673 27 and $798 17 for each farm connected (See Table 14.) The lower figure is based on 1939 prices, with 80% of the available farms taking service. The higher figure is based on 1942 prices, with 60% of the available farms taking service. These amounts cover the total cost of all construction from the Manitoba Power Commission's rural network to the meter on the customer's premises. This Commission strongly recommends that the line be brought right into the farmer's yard without the farmer making any cash contribution, otherwise unduly low saturation will prevail. It includes also the additional capital expenditure on the Commission network required for the farm load It does not include a portion of the existing network capital which is provided for as a farm line operating expense in subsequent analysis

Typical Manitoba Power Commission Farm Line

The costs are based on the average conditions for 53,000 farms and on an average length of farm line of 0 73 miles for 80% saturation and of 0.85 miles for 60% saturation The costs are confirmed by the experience of the Manitoba Power Commission in building lines of the same design during recent years.

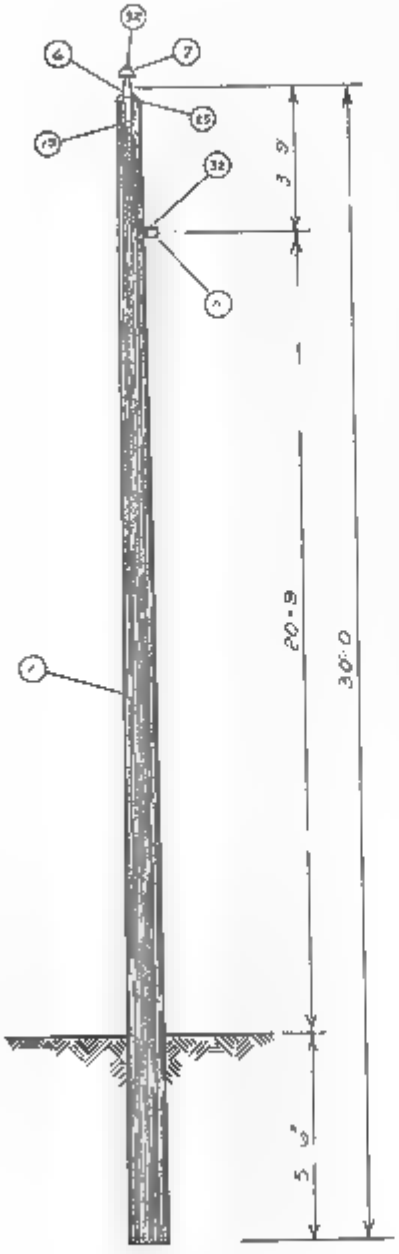


BILL OF MATERIAL

ITEM	[illegible]	[illegible]	MATERIAL
1	1		30' Pole
2		.	Steel Pin 1074
3		.	Insulator, 506
4	1		Cooke Dead Ends Bkt
5	1		Secondary Rack 3 pt
6	.		Secondary Cooke Dead End
7	.		Transformer 3KVA 4600V 230/115 Pivot
8			Dropout Fuse (and Fuse)
9			Lightning Arrestors
10	3"	3	Ground Wire Nº 6 DBWP Strd
11			Ground Rod
12	5'	15'	Mould
13	7	6	" Staple
14	1	.	Anchor
15	1		Anchor Shield
16	2	2	Pole Plates
17	4	4	Guy Clamps
18	7"	6'	Wire 3/8"
19	.		Strain Ins.
20	2	3	Lag Screws
21	2	2	5/8"x10" Machine Bolts
22	2		5/8"x12"
23	2		5/8"x16"
24	6	2	2¼" Washers
25	35"		Copperweld Wire Nº 3/12
26	6	4	Copper Connectors KS20
27		2	Al/Cu. Connector . Bolt
28	4		1" Pipe Clips
29	2		Locknuts
30			1" Bushing
31	20		1" Conduit
32			"P" Condulet & Hole Porcelain Cover
33	.		LB " Blank Cover
34			Nipple
35	100'		Wire Nº 8 SBRC
36	3		Pulley Knobs
37	.		Comb. Meter and Switch Box
38			Meter 15A 240V. 3W.
39			
40			
41			
42			
43			
44			
45			

Scale ¼" = 1'-0"

FARM SERVICE POLE



BILL OF MATERIAL

ITEM	QTY	MATERIAL
1	1	40' Pole
2		
3		
4		
5		
6	1	Steel Pole Top Pin
7	1	Insulator 505
8		
9		
10		
	1	Secondary Spool Fitting
12		
13		
14		
15		
16		
17		
18		
19	1	Lag Screw
20		
21		
22		
23		
24		
25		5/8" x 10" Machine Bolts
26		
27		
28		
29		
30		2½ Washer
31		
32		Copperweld Wire #9/12
33		
34	1/2	Lorner Tie Wire NP6
35		

Scale. 1/4"=1'-0"

STANDARD FARM LINE POLE

The design of the standard single-phase farm line is for 4,600 volts, vertical construction, with western red cedar poles spaced 310 feet apart. Included in the capital cost is a farm yard service pole, a 3 K.V.A. transformer, protective equipment, and meter The type of construction and schedule of material are shown in diagrams on pages 111 and 112

TABLE 14—AVERAGE CAPITAL COST PER FARM FOR ELECTRIFICATION

	1939 Prices		1942 Prices	
	80% Saturation	60% Saturation	80% Saturation	60% Saturation
Line on road allowance	$317 50	$377 50	$352 43	$419 05
Tap-off and service	296 00	296 00	310 00	310 00
Additional rural network cost	25 00	25 00	27 50	27 50
Miscellaneous costs	34 77	38 21	37 81	41 64
	$673 27	$736. 71	$727 74	$798 17

The selection of a line pressure of 4,600 volts as the farm line standard is influenced by the voltage of the existing rural network of the Manitoba Power Commission. Where such influence does not exist, it is probable that a standard of 6,900 volts will be adopted. The increase in the capital cost per mile for the higher voltage line is very small.

Before the amount of capital required for farm lines can be determined it is first necessary to decide both on the period over which the work will be carried out and on the number of farms that can be served in the selected time. In order to build up an efficient staff organization and obtain low costs it is desirable that the work proceed at a sustained rate over a period of time sufficient to engage a regular construction crew It is recommended that the schedule of farm connections given in Table 15 be maintained, but it is quite practicable to accelerate the schedule if desired

TABLE 15—PROPOSED PROGRAMME OF FARM CONNECTIONS

Year	Annual Farm Connections	Total Farm Connections
1st	1,000 farms	1,000 farms
2nd	1,500	2,500
3rd	2,000	4,500
4th	2,500	7,000
5th	3,000	10,000
6th	3,000	13,000
7th	3,000	16,000
8th	3,000	19,000
9th	3,000	22,000
10th	3,000	25,000
Thereafter annually	3,000	

In dealing with costs in this report no attempt has been made to set forth details beyond the first ten years. In this period it is assumed that

25,000 farms will be connected. With a total of 53,000 farms in the service area and a saturation of 80%, 42,400 farms would be the number connected. A ten-year programme of 25,000 farm services respresents approximately 42% of all the farms in the province, not including the 1,100 already connected.

Tables 16 and 17 give the progressive capital expenditure for electrification of 25,000 farms and include for convenience the concurrent capital expenditure on the Manitoba Power Commission's network extensions referred to at the beginning of this chapter. The tables are based on 1939

TABLE 16—CAPITAL EXPENDITURE FOR ELECTRIFICATION OF 25,000 FARMS AND $2,500,000 EXTENSION TO MANITOBA POWER COMMISSION'S NETWORK 1939 PRICES AND 80% FARM SATURATION

Year of Construction	Capital for Network Extension	Capital for Electrification (25,000 Farms)	Total Capital Each Year	Accumulated Total
1st	$ 500,000 00	$ 673,267 50	$ 1,173,267 50	$ 1,173,267 50
2nd	500,000 00	1,009,901 25	1,509,901 25	2,683,168 75
3rd	500,000 00	1,346,535 00	1,846,535 00	4,529,703 75
4th	500,000 00	1,683,168 75	2,183,168 75	6,712,872 50
5th	500,000 00	2,019,802 50	2,519,802 50	9,232,675 00
6th		2,019,802 50	2,019,802 50	11,252,477 50
7th		2,019,802 50	2,019,802 50	13,272,280 00
8th		2,019,802 50	2,019,802 50	15,292,082 50
9th		2,019,802 50	2,019,802 50	17,311,885 00
10th		2,019,802 50	2,019,802 50	19,331,687 50
	$2,500,000 00	16,831,687 50	$19,331,687 50	

TABLE 17—CAPITAL EXPENDITURE FOR ELECTRIFICATION OF 25,000 FARMS AND $2,500,000 EXTENSION TO MANITOBA POWER COMMISSION'S NETWORK (1939 PRICES AND 60% FARM SATURATION

Year of Construction	Capital for Network Extension	Capital for Electrification (25,000 Farms)	Total Capital Each Year	Accumulated Total
1st	$ 500,000 00	$ 736,713 00	$ 1,236,713 00	$ 1,236,713 00
2nd	500,000 00	1,105,069 50	1,605,069 50	2,841,782 50
3rd	500,000 00	1,473,426 00	1,973,426 00	4,815,208 50
4th	500,000 00	1,841,782 50	2,341,782 50	7,156,991 00
5th	500,000 00	2,210,139 00	2,710,139 00	9,867,130 00
6th		2,210,139 00	2,210,139 00	12,077,269 00
7th		2,210,139 00	2,210,139 00	14,287,408 00
8th		2,210,139 00	2,210,139 00	16,497,547 00
9th		2,210,139 00	2,210,139 00	18,707,686 00
10th		2,210,139 00	2,210,139 00	20,917,825 00
	$2,500,000 00	$18,417,825 00	$20,917,825 00	

prices and figured for 80% and 60% saturation. To obtain approximate totals for 1942 prices, 8% should be added to the 1939 prices. The totals do not include the capital required for general extensions to the properties of the system of the Manitoba Power Commission in the towns and villages now served. Nor do they represent net debt until an adjustment has been made for accumulated sinking fund.

Annual Expense of Manitoba Farm Electrification

The first and largest item of annual expense to be considered is the fixed charges on the capital debt. In view of the desirability of farm electrification as one of the postwar reconstruction activities, there is every likelihood that provisions can be made to finance the capital expenditure at a low rate of interest. The Dominion Government, through the appointment and work of the Committee on Reconstruction, has indicated clearly its intention of giving financial encouragement to postwar reconstruction and may be relied on to play a leading part in the provision of low-cost money for approved works.[3] Securing adequate capital funds at the lowest possible rate of interest is indispensable to the success of farm electrification. To attempt to proceed without it would be to court failure.

Dominion bonds at the present time yield approximately 3%. Manitoba bonds are yielding about 1% higher. The Rural Electrification Administration in the United States obtains federal funds at an average rate of 2.46%. With these existing rates in mind and the strong possibility of a sharp reduction for work-creating projects, the Commission has assumed a maximum interest rate of 3½% for farm electrification.

Typical Manitoba Power Commission Farm Line

It is recommended that the farm electrification debt be amortized over twenty-five years as is done by the R.E.A. co-operatives. This period of time is not greater than the average life of the physical properties. An annual levy of 2.75% will provide the necessary sinking fund, provided that the earnings remain in the fund. With the debt completely provided for within the average life of the properties, no levies are required for depreciation or replacement of properties. The total fixed capital charges thus becomes 6.25%. Tables 18 and 19 show the net debt for farm electrification[4] at the end of each year of the first ten-year period, reaching a total at the end of that time of $14,426,800.52 on the basis of 80% saturation and $15,786,818.08 on the basis of 60% saturation.

Previously in this chapter it has been pointed out that it is not practical to separate the operation of a farm electrification system in Manitoba from

[3]See Chapters V and X.

[4]Not including the $2,500,000 for the Manitoba Power Commission network for small urban communities.

TABLE 18—CAPITAL REQUIREMENTS FOR FARM ELECTRIFICATION ON THE BASIS OF 80% SATURATION AND 1939 PRICES*
(Statement of capital required each year, annual sinking fund payment to discharge capital in 25 years at 2·75%, annual interest earnings on sinking fund at 3%, and net debt at each year-end for ten years in adding 25,000 farms to the system.)

Year	Capital Required Each Year	Accumulated Total	Annual Sinking Fund Payment at 2·75%	Annual Interest Earnings at 3%	Sinking Fund Payments and Annual Interest Earnings	Net Debt at Each Year-End
1st	$ 673,267 50	$ 673,267 50	$ 18,514 86	$	$ 18,514 86	$ 654,752 64
2nd	1,009,901 25	1,683,168 75	46,287 14	555 45	65,357 45	1,617,811 30
3rd	1,346,535 00	3,029,703 75	83,326 85	1,960 72	150,635 02	2,879,068 73
4th	1,683,168 75	4,712,872 50	129,593 09	4,519 05	284,758 06	4,428,114 44
5th	2,019,802 50	6,732,675 00	185,143 66	8,542 74	478,440 36	6,254,225 64
6th	2,019,802 50	8,752,477 50	240,693 13	14,353 48	733,495 97	8,018,981 53
7th	2,019,802 50	10,772,280 00	296,237 70	22,004 88	1,051,738 55	9,720,541 45
8th	2,019,802 50	12,792,082 50	351,782 27	31,552 16	1,435,072 98	11,357,009 52
9th	2,019,802 50	14,811,885 00	407,326 84	43,052 19	1,885,452 01	12,926,432 99
10th	2,019,802 50	16,831,687 50	462,871 41	56,568 56	2,404,888 98	14,426,800 52
	$16,831,687 50		$2,221,782 75	$183,104 23		

*It has been assumed that the capital required will be borrowed at the first of each year, the sinking fund payment will be made at each year-end, interest at 3% will be added annually at each year-end

TABLE 19—CAPITAL REQUIREMENTS FOR FARM ELECTRIFICATION ON THE BASIS OF 60% SATURATION AND 1939 PRICES*
(Statement of capital required each year, annual sinking fund payment to discharge capital in 25 years at 2·75%, annual interest earnings on sinking fund at 3%, and net debt at each year-end for ten years in adding 25,000 farms to the system.)

Year	Capital Required Each Year	Accumulated Total	Annual Sinking Fund Payment at 2·75%	Annual Interest Earnings at 3%	Sinking Fund Payments and Annual Interest Earnings	Net Debt at Each Year-End
1st	$ 736,713 00	$ 736,713 00	$ 20,259 61	$	$ 20,259 61	$ 716,453 39
2nd	1,105,069 50	1,841,782 50	50,640 02	607 73	71,516 42	1,770,266 08
3rd	1,473,426 00	3,315,208 50	91,168 23	2,145 49	164,830 14	3,150,378 36
4th	1,841,782 50	5,156,991 00	141,817 25	4,944 90	311,592 29	4,845,398 71
5th	2,210,139 00	7,367,130 00	202,596 07	9,347 77	523,536 13	6,843,593 87
6th	2,210,139 00	9,577,269 00	263,374 90	15,706 03	802,617 11	8,774,651 89
7th	2,210,139 00	11,787,408 00	324,153 72	24,078 51	1,150,849 34	10,636,558 66
8th	2,210,139 00	13,997,547 00	384,932 54	34,525 48	1,570,307 36	12,427 239 64
9th	2,210,139 00	16,207,686 00	445,711 36	47,109 22	2,063,127 94	14,144,558 06
10th	2,210,139 00	18,417,825 00	506,490 19	61,893 84	2,631,511 97	15,786,313 03
	$18,417,825 00		$2,431,152 89	$200,859 08		

*It has been assumed that the capital required will be borrowed at the first of each year, the sinking fund payment will be made at each year-end, interest at 3% will be added annually at each year-end

the rural network of the Manitoba Power Commission system. It follows, therefore, that farm electrification should be governed by the same legislation which is now embodied in the Manitoba Power Commission Act. This act has been taken as a guide in assessing the extent to which the Province of Manitoba will give financial aid to the farm project. It provides for a bonus equal to the interest and sinking fund on one-half the capital. It may be expressed equally well as one-half the interest and one-half the sinking fund on the total capital, or 3.125%. (A full discussion of the section of the act dealing with the bonus will be found in Chapter XII.) The farm line capital charges per month per farm, on completion of the first ten years, deducting the bonus, are estimated to be as follows: at 1939 prices, $1.75 for 80% saturation and $1.92 for 60% saturation, at 1942 prices, $1.89 for 80% and $2.08 for 60% saturation.

All items of annual expense arising directly out of farm electrification, or chargeable as an indirect expense against farm electrification, have been provided for. These items include:

Farm line capital charges
Farm line operating costs
Farm line billing and collections
Farm line business promotion
Farm line management
Farm line energy costs
Share of Manitoba Power Commission network costs

The share of Manitoba Power Commission network costs is based on an estimated average demand per farm of 600 watts. It is not an out-of-pocket expense, as the additional network capital required for the farm load has been provided for as part of the farm line capital. Virtually it represents a saving gained by the co-ordination of the farm electrification project with the Manitoba Power Commission system, and may be used temporarily for the purpose of assisting farm electrification in the early stages of its develop-

TABLE 20—ANNUAL EXPENSE PER FARM CUSTOMER PER MONTH, EXCLUSIVE OF THE COST OF ENERGY

Expense	1939 Prices		1942 Prices	
	80%	60%	80%	60%
Capital charges at 3.125%	$1.75	$1.92	$1.89	$2.08
Farm line operating expense	.93	1.09	.93	1.09
Billing and collections	.14	.14	.14	.14
Business promotion	.08	.08	.08	.08
Management	.06	.06	.06	.06
Share of network costs*	.62	.62	.62	.62
	$3.58	$3.91	$3.72	$4.07

*It might have been more accurate to state this item of 62c per farm per month as a variable expense, instead of a constant expense based on an average demand of 600 watts per farm. However, as it is only a cross-entry in the combined accounts of the Manitoba Power Commission and the farm electrification system, and not an out-of-pocket expense, it is more convenient to express it as a constant amount.

ment. Exclusive of the cost of energy, the annual expense for each farm served becomes practically constant for each assumed condition of saturation and price base. These constant costs are given in Table 20.

Typical Manitoba Power Commission Farm Line and Street Lighting in Small Hamlet

The estimate of farm line operating expense is based on the experience of the Manitoba Power Commission with lines of similar design. It assumes a considerable amount of co-operation from the farm customer, but no more than has been customary with the R.E.A. co-operatives in the United States.[5] It is impossible to give farm service at reasonable rates and at the same time have a large staff of employees continuously patrolling farm lines or making long trips in response to minor trouble calls. This fact must be well understood at the outset and arrangements made for smooth working co-operation between the farm customer and the local district supervisor

Distance does not permit the same procedure for meter reading as prevails in the towns and villages. A thoroughly tested system in which the customer reads his own meter and forwards the information with payment regularly on a special card has been in successful operation for several years in the United States. With this system it will be possible to perform the billing and collection operations at a cost of 14c per farm customer per month.

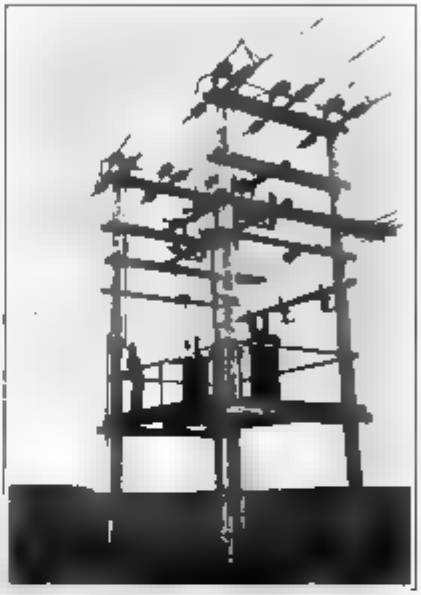
Except for the initial business promotion work, all subsequent costs of this nature are charged as operating expenses. It is estimated that for 25,000 farms, which is the assumed number of customers in the tenth year, $24,000 per annum will be sufficient for the work. This amounts to 8c per customer per month. Management costs of $18,000 per annum, or 6c per customer per month, have been included.

The Cost of Energy

Hydro-electric power for farm electrification can be supplied by the Manitoba Power Commission from its existing or extended rural network. The Commission now purchases power in bulk from the Winnipeg Electric Company, taking delivery at Winnipeg at a price specified in the agreement

[5]See Chapter X

which the province made with the company in April, 1928. Section 3 (a) of the agreement governs the price of power.* The average price for energy in 1941 under this agreement was 0.303c per kwhr. Assuming an average of 50% loss between Winnipeg and the point of delivery at the farm, the approximate cost of energy delivered to the farm is 0.75c per kwhr.



MANITOBA POWER COMMISSION SMALL RURAL SUBSTATION

The maximum amount of power to be delivered under the agreement is 30,000 horsepower (Section 2 a) and the period of time 30 years (Section 8). In the event of the province requiring more than 30,000 horsepower, the price to be paid for the additional power is to be determined by agreement, or failing that, by the Municipal and Public Utility Board of the Province of Manitoba (Section 10). The amount of power now purchased under the agreement is 20,000 horsepower. The unexpired term of the agreement is twenty years. In the proposed plan of farm electrification it is estimated that 25,000 farmers, with an average demand of 600 watts per farm, will be connected in the first ten years. This will increase the power to be purchased by the Manitoba Power Commission to an amount considerably in excess of 40,000 horsepower. It has been assumed for this investigation that the

*The Minister agrees

(a) to pay to the Power Company for all power delivered to the Minister in monthly payments in lawful money of Canada at Winnipeg at the following schedule of rates based on the maximum twenty (20) minute integrated demand, namely

at a rate which shall not be more than the rate of Thirteen Dollars and Eighty Cents ($13.80) per horsepower per annum, nor less than the rate of Eleven Dollars ($11.00) per horsepower per annum and within these limits at the rate of One-Half Cent (½c) per kilowatt hour each month a payment to be made as though the maximum twenty (20) minute integrated demand taken during the month were taken for the whole month, provided, that the price to be paid for power according to the said schedule of rates shall include all water rentals payable under the lease of Seven Sisters Falls, whether by the Power Company, the Winnipeg Electric Company or otherwise provided, further that if additional charges for water rentals in excess of those charged under the said lease, be imposed by the Dominion or Manitoba Government, and the cost of power be thereby increased to the Company, the Minister shall pay to the Power Company such additional amount each month as shall exactly compensate the Power Company for the said increase in cost of power in respect of the power delivered to the Minister.

Provided, that the Minister shall not be required to pay in any month for more power than the power actually delivered to the Minister as measured and on the basis set out in this clause 3a., and provided further the Minister shall not be obliged to take the power covered by this Agreement, or any part thereof if the Minister so decides. (Report Relating to Development of Seven Sisters Power Site and Agreement for Supply of Power to Provincial Hydro-Electric System, 1928, pp. 93ff.)

present contract price for power will continue for amounts in excess of 80,000 horsepower. If the price is increased, an equivalent adjustment will be required in the estimate of the cost of farm service operation.

Growth in Use of Energy

The cost of energy for farm electrification is a variable monthly expense, depending on the needs of the farm customer and his ability to acquire electrical apparatus and appliances. The high capital expenditure per farm in Manitoba, approximately $673, makes full utilization of the service essential. Electricity for lighting only cannot be given without ultimate

Table 21—Estimated Increase in Use of Electricity by Farm Customers in Manitoba

Year	Average Monthly Consumption
1st	50 kwhr
10th	100 kwhr
Increase for 9 years	100%

dissatisfaction, and it cannot be stressed too strongly that those who are responsible for the management of the proposed project should not install farm service without adequate assurance that the farmer is equipped to make proper utilization of the investment. It is desirable that the average consumption per farm should increase from 50 kwhr per month in the first year to 100 kwhr per month in the tenth year. This rate of increase would result in a farm electrification system that is financially sound and, with the aid of the bonus provided under the Manitoba Power Commission Act, well able to carry itself without additional financial assistance.

For the purposes of comparison, the estimated rate of increase in the utilization of electricity by Manitoba farm customers (Table 21) is compared with actual experience elsewhere (Tables 22 and 23). The influence that the

Table 22—Increase in Use of Electricity by R.E.A.-Financed Co-Operatives*

Months in Operation	Average Monthly Consumption
1- 6	39.0 kwhr
7-18	43.2
19-30	46.9
31-42	55.3
43 and over	60.0
Increase for 3 years	42%

*R.E.A. Annual Report, 1941

record consumption of electricity in Winnipeg will have on farm customers in Manitoba cannot be overlooked. As far as rates are concerned, no change of any importance has been made in Winnipeg since 1921. It is conclusive,

TABLE 23—INCREASE IN USE OF ELECTRICITY BY DOMESTIC CUSTOMERS OF WINNIPEG HYDRO ELECTRIC SYSTEM IN TEN-YEAR PERIOD FOLLOWING LAST WAR

Year	Average Monthly Consumption	Average Monthly Consumption Less Water Heaters
1921	100 kwhr	98 kwhr
1922	119	94
1923	158	112
1924	181	116
1925	205	121
1926	226	128
1927	255	135
1928	282	141
1929	312	148
1930	334	150
1931	347	156
Increase for 10 years	247%	77%

therefore, that a vigorous appliance merchandising policy is the key to the situation.

The estimated total operating costs per farm are given in Table 24 for various conditions of saturation, price base, and monthly consumption. Annual expenses under a wide variety of conditions have been given to

TABLE 24—OPERATING COSTS PER FARM CUSTOMER PER MONTH AT THE TENTH YEAR, ASSUMING AN AVERAGE MONTHLY CONSUMPTION FROM 50 TO 100 KWHR.

Operating Condition	Monthly Consumption	Constant Expense	Cost of Energy	Total Costs
80% saturation, 1939 prices	50 kwhr	$3 58	$ 37	$3 95
	60	3 58	45	4 03
	70	3 58	52	4 10
	80	3 58	60	4 18
	90	3 58	67	4 25
	100	3 58	75	4 33
80% saturation, 1939 prices	50 kwhr	$3 91	$ 37	$4 28
	60	3 91	45	4 36
	70	3 91	52	4 43
	80	3 91	60	4 51
	90	3 91	67	4 58
	100	3 91	75	4 66
80% saturation, 1942 prices	50 kwhr	$3 72	$ 37	$4 09
	60	3 72	45	4 17
	70	3 72	52	4 24
	80	3 72	60	4 32
	90	3 72	67	4 39
	100	3 72	75	4 47
80% saturation, 1942 prices	50 kwhr	$4 07	$ 37	$4 44
	60	4 07	45	4 52
	70	4 07	52	4 59
	80	4 07	60	4 67
	90	4 07	67	4 74
	100	4 07	75	4 82

demonstrate fully their relative importance in the cost of operation. If an average consumption of 100 kwhr per month is reached, the total cost of operation at 1939 prices will be $4.33 per month for 80% saturation and $4.66 per month for 60% saturation. These costs indicate what the ultimate steady cost conditions are likely to be, and serve as the principal guide in the selection of a rate schedule for farm service.

Rates for Farm Electrification Service

Assuming that the present bonus as set forth in the Manitoba Power Commission Act is applied to farm electrification, the following rate schedule for farm electrification service is recommended by this Commission:

For the first 50 kwhr each month	8c per kwhr
For all additional energy each month	2c per kwhr
Prompt payment discount	10%
Minimum net monthly bill	$3.60

Under this schedule the farmer would pay the net amounts each month contained in Table 25

Table 25—Cost to Farm Customer for Electric Service

Monthly Consumption	Net Bill	Net Rate Per Kwhr
50 kwhr	$3 60	7 2c
60	3 76	6. 3c
70	3 95	5 6c
80	4 14	5 2c
90	4 32	4 8c
100	4 50	4 5c
200	6 30	3 15c

The selection of a suitable rate involves many considerations, some of which cannot be satisfied without adversely affecting others. Experience has shown that rates should be of a type easily understood by customers and acceptable to them in a degree which will encourage maximum utilization of the service. They should also be set so that the rates for different types of service are sufficiently uniform to avoid complaints that they are discriminatory. The three principal points on which the above farm rate recommendations are based are.

1. On the assumption that in respect to bonus payments farm electrification will be governed by the terms of the Manitoba Power Commission Act, the revenue from the proposed farm rate will be adequate to pay all costs.

2. The proposed farm rate shall be the same as the standard uniform domestic rates applicable to towns where the service charge has been eliminated, with the exception that a higher minimum monthly bill is required to protect the large investment in farm service.

3. The proposed rate shall be of a promotional character in order that the farmer will be encouraged to utilize electricity for all types of domestic and farm equipment

The first condition is satisfied by examination of the cost of operation and revenue under the conditions of saturation and price base contained in Table 26.

At the end of ten years it is expected that the average monthly consumption, with 80% saturation and a price base similar to that prevailing in 1939, will be 100 kwhr per month If this is the case, the surplus per farm per month will be 17c. For 25,000 farms this monthly surplus is equivalent to $51,000 per annum. It is inconceivable that the monthly consumption at the end of ten years will be as low as 50 kwhr per month,

Manitoba Power Commission Winnipeg-Portage Transmission Line

Table 26. Comparison of Total Monthly Operating Cost and Revenue with Bonus Per Farm at End of Ten Years

Operating Condition	Monthly Consumption	Total Cost	Net Revenue	Profit or Loss	Available from Saving by Co-ordination with Manitoba Power Commission
80% saturation, 1939 prices	50 kwhr	$3 95	$3 60	$ 35	+$ 62
	60	4 05	3 78	— 25	+ 62
	70	4 10	3 95	15	+ 62
	80	4 18	4 14	— 04	+ 62
	90	4.25	4 32	+ 07	+ 62
	100	4 33	4 50	+ 17	+ 62
60% saturation, 1939 prices	50 kwhr	$4 28	$3 60	—$ 68	+$ 62
	60	4 30	3 78	— 58	+ 62
	70	4.43	3 95	48	+ 62
	80	4 51	4 14	— 37	+ 62
	90	4.58	4.32	26	+ 62
	100	4 66	4 50	- 16	+ 62
80% saturation, 1942 prices	50 kwhr	$4 09	$3 60	—$ 49	+$ 62
	60	4.17	3 78	— 39	+ 62
	70	4 24	3 95	- 29	+ 62
	80	4 32	4 14	— 18	+ 62
	90	4.39	4 32	07	+ 62
	100	4.47	4 50	+ 03	+ 62
60% saturation, 1942 prices	50 kwhr	$4.44	$3.60	—$ 84	+$ 62
	60	4 52	3 78	74	+ 62
	70	4 59	3 95	— 64	+ 62
	80	4 67	4.14	— 53	+ 62
	90	4 74	4.32	— 42	+ 62
	100	4 82	4 50	— 32	+ 62

but even in this event there is sufficient saving by co-ordination of the farm electrification system with the Manitoba Power Commission system to provide for any deficiency in revenue

Experience of the R E A supports the conclusion that the number of customers with minimum monthly bills at the end of the tenth year is likely to be small The following figures are reported for March, 1941

	Length of Operation				
	1-6 Mos	*7-18 Mos.*	*19-30 Mos*	*31-42 Mos.*	*43 Mos. and Over*
Customers with minimum bills	70%	55%	52%	46%	38%

The second of the above conditions is satisfied by adopting the two-block rate of 8c and 2c which has now been adopted by the Manitoba Power Commission as the standard uniform domestic rate in rural towns This rate is now being progressively applied to all towns served by the Commission as soon as conditions permit the change

The third condition is satisfied to the extent of providing a low rate after 50 kwhr per month have been consumed. Consideration was given to the adoption of a three or four-block promotional rate, as the multi-block rate has proved to be popular elsewhere. Against its adoption, however, is the desirability of conformity with Manitoba Power Commission two-block rates.

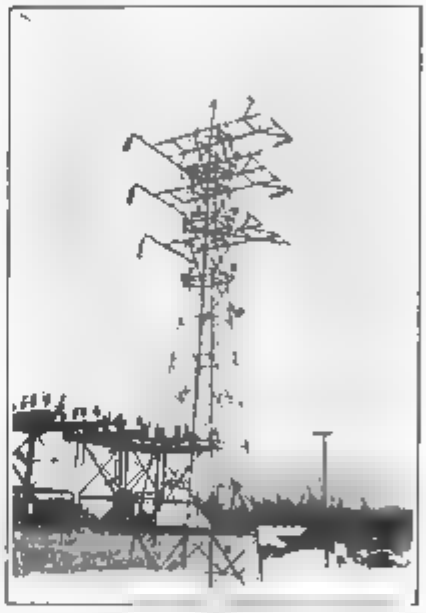
Bonus Requirements

In Chapter XII, under the heading of Manitoba Power Commission Extension Account, a full explanation will be found of the manner in which water power rentals are transferred and used as a bonus for the Commission's rural electrification network Here it may be noted that if there are insufficient funds in the Extension Account the lieutenant-governor-in-council may raise by loan or loans under the Manitoba Loans Act such sum or sums of money as he may deem expedient for the purpose (Section 8 (3), Manitoba Power Commission Act)

Table 27—Bonus Required for 25,000 Farms, Based on 3.125% of Capital Expenditure for 30% and 60% Saturation 1939 Prices

Year	Bonus Required	
	30% Saturation	60% Saturation
1st	$ 21,000	$ 23,000
2nd	52,500	57,500
3rd	94,700	103,500
4th	147,000	161,000
5th	210,000	230,000
6th	273,500	299,500
7th	336,500	368,500
8th	400,000	437,500
9th	463,000	506,500
10th	526,000	575,500

If, as has been assumed, a farm electrification programme will be governed by the Manitoba Power Commission Act and will receive an annual bonus of $ 125% on the capital expenditure, the amount of money required will be greatly in excess of the amount received from water power rentals. Table 27 sets forth the bonus requirements for the first ten years of farm electrification. Expressed in terms of annual bonus per farm, $21.00 is required for 80% saturation and $23.00 for 60% saturation. In terms of monthly bonus per farm, $1.75 is required for 80% saturation and $1.91 for 60% saturation. The best that can be expected under the present system is that the increase in water rentals resulting from the increase in production of electric power will be sufficient under the present water rental charges to provide the bonus requirements of the existing Manitoba Power Commission system and its projected extensions to the remaining towns and villages. The additional amount of money required as a bonus for farm electrification will not be available under the terms of the long-term agreements made between the Province of Manitoba and the lessees of the water power sites.



Manitoba Power Commission Take-off Tower on Transmission Line

Energy Rates Essential if no Bonus were Provided

Some consideration may now be given to the financing of farm electrification in the event that the funds required for providing a bonus at the rate specified under the Manitoba Power Commission Act are not available. In this instance the government would be compelled to adopt energy rates for farm electrification so that there would be sufficient revenue without bonus, or to adopt an intermediate policy in which the funds available for bonus would be distributed in some equitable manner between the farm lines and the rural electrification system of the Manitoba Power Commission. At this point it should be noted that the Manitoba Power Commission Act includes farm lines as eligible for bonus, also that there is nothing in the act which gives past capital expenditure precedence over future capital expenditure in respect to bonus payments.

While the Commission does not recommend the adoption of a farm energy rate based on the assumption that funds are not available for farm line bonus, it indicates, nevertheless, what that rate might be for the purpose

of showing the limits between which government policy may be set. Furthermore, it should be noted that it is only when the average monthly consumption is in excess of 90 kwhr per month that the loss of the bonus is entirely compensated for, and that in the early stages of development all the benefits accruing from the co-ordination of farm electrification with the Manitoba Power Commission System would be used for the maintenance of the lowest possible farm rate. Without bonus the following rate schedule for farm electrification would be required

For the first 50 kwhr per month	.10c per kwhr
For the next 50 kwhr per month	4c per kwhr
For all additional energy per month	2c per kwhr
Prompt payment discount	10%
Minimum net monthly bill	$4 50

Under this schedule the farmer would pay the net amounts each month shown in Table 28.

TABLE 28—NET MONTHLY BILL AND RATE PER KWHR FOR FARM ELECTRIFICATION SYSTEM NOT RECEIVING A BONUS

Monthly Consumption	Net Bill	Net Rate Per Kwhr
50 kwhr	$4 50	9 0
60	4 86	8 1
70	5 22	7 5
80	5 58	7 0
90	5 94	6 6
100	6 30	6 3
200	8 10	4 05

Table 29 has been prepared to show the monthly costs and revenue if no bonus is paid. This table is a partial counterpart to Table 26.

TABLE 29—MONTHLY OPERATING COST AND REVENUES PER FARM. FIRST TO TENTH YEAR, WITH NO BONUS (50% SATURATION AND 1939 PRICES)

Monthly Consumption	Total Cost No Bonus	Net Revenue	Profit or Loss	Available from Saving by Co-ordination with Manitoba Power Commission
50 kwhr	$5 70	$4 50	—$1 20	+$0 62
60	5 78	4 86	0 92	+ 0 62
70	5.85	5.22	— 0 63	+ 0 62
80	5.93	5.58	— 0 35	+ 0 62
90	6.00	5.94	— 0 06	+ 0 62
100	6.08	6.30	+ 0 22	+ 0 62

It will be noted that with the aid of the saving available by co-ordinating the farm electrification system with that of the Manitoba Power Commission, the suggested rate could be adopted, provided that the average monthly consumption is maintained at not less than 70 kwhr. It is the opinion of this Commission that this average monthly consumption can be attained in the development of farm electrification, furthermore, that it will be substantially exceeded before the fifth year of operation.[7] However, at this higher price

[7]Based on R.E.A. experience and the substance of Chapter IV. See also Chapter X.

for service, a high saturation would be more difficult to obtain and farmers might be expected to show some resistance in installing heavy energy-using equipment. Yet, unless the farmer can make electricity work for him, the major purpose of farm electrification is defeated.

Only on the basis of experience gained during the first ten years of the farm electrification programme will it be possible to estimate the number of farms that can be served after the first 25,000 are connected. If 80% is the ultimate point of saturation, approximately 15,000 farms will remain to be served. Whether this degree of saturation over the whole service area will be reached in Manitoba cannot be forecast, but if it is, an additional sum of $10,000,000 will be required for capital expenditure and $300,000 per annum for bonus on the present Manitoba Power Commission basis.

Farm Wiring and Appliances

Revenue sufficient to justify the heavy capital expenditure required for farm electrification service in Manitoba can be obtained only through liberal use of the electrical appliances and equipment which the farmer acquires. The means by which the farmer may acquire this material quickly and cheaply therefore becomes an essential feature of the undertaking.

Unless all other methods fail, it is not considered advisable that the province finance the farmer's purchases of wiring and appliances, but it is necessary that the government institution operating the farm electrification system act as the agent between the manufacturer and the consumer, so that the goods may be sold to the farmer at as near factory cost as possible.[8]

The proposal is made to offer electrical wiring and equipment to the farmer in three standard packages, as shown in Table 30

Table 30—Proposed Standard Packages of Electrical Wiring and Equipment

		List 1939	*Net 1939*
I	A minimum package, consisting of:		
	Cost of wiring house and outbuildings	$ 150 00	$ 150 00
	Washing machine	100 00	60 00
	Miscellaneous small appliances	50 00	30 00
		$ 300 00	$ 240.00
II	An intermediate package.		
	Cost of wiring house and outbuildings	$ 225 00	$ 225.00
	Washing machine	100.00	60 00
	Miscellaneous small appliances	50 00	30.00
	Refrigerator (6 cu. ft.)	225 00	135 00
	Fractional motors and adapter	100.00	90 00
		$ 700.00	$ 540 00
III	A complete package:		
	Cost of wiring house and outbuildings	$ 250.00	$ 250.00
	Washing machine	100.00	60 00
	Miscellaneous small appliances	50 00	30 00
	Refrigerator (6 cu. ft.)	225 00	135 00
	Motors and adapter	225.00	202.50
	Electric radio	100.00	60.00
	Electric range	125 00	75 00
	Pressure water system	600 00	540 00
	Vacuum cleaner	50 00	30 00
		$1,725 00	$1,382 50

[8]For a comprehensive discussion of this problem see Chapter X.

The price paid by the farmer would be the net price plus the cost of handling, including financial charges if payments are made in instalments. The goods included in any one package would be subject to variation to suit the customer's taste and requirements, the items and prices listed herein being only for the purpose of indicating the scope of the proposal

The scheme may have very attractive features from the point of view of the manufacturer, as it would provide a steady schedule of factory output over a period of at least ten years. The total net price for wiring and appliances for 25,000 farms is estimated to be $14,337,500. Of this amount the manufacturers of electric wiring and appliances would receive the full amount less approximately $1,250,000 for wiring labour.

The total net cost of different packages of wiring and appliances for 25,000 farms is as follows

11,250 farms, minimum package at $240.00	$ 2,700,000
5,750 farms, intermediate package at $540.00	4,725,000
8,000 farms, complete package at $1,382.50	6,912,500
	$14,337,500

Summary and Conclusions

A farm electrification programme in Manitoba should be operated as part of the system of the Manitoba Power Commission. Apart from the handicap of high capital expenditure, farm service merely means another type of consumer added to the Commission's rural network.

The system of the Manitoba Power Commission is in a sound financial position. As soon as the war terminates, its rural network will be extended to serve the towns and villages not now using hydro-electric power. The capital cost of this extension is estimated to be $2,500,000. This extension will facilitate the farm electrification progress by increasing the number of points from which farm lines may be run.

The annual water power rentals, after paying water power administration expenses, are only $87,000 in excess of the amount required for the present Manitoba Power Commission bonus.

Based on 80% saturation, 43,000 farms are potential customers in a plan of farm electrification. Of this number it is estimated that 25,000 may be connected in the first ten years at a capital cost of $673.27 per farm, or a total of $16,831,687.50. These figures are based on 1939 costs. After deducting the accumulated sinking fund, the net debt at the end of the first ten years will be $14,426,800.52.

It is assumed that the interest rate on capital will not exceed 3½%, the sinking fund rate 2.75%, the total capital fixed charges 6.25%. If a bonus is paid equivalent to the interest and sinking fund on one-half the capital, the net fixed charges may be taken as 3.125% on the total capital.

If a bonus of 3.125% is paid, the 8c and 2c two-block rate now adopted as the uniform rate for towns and villages may also be adopted for farm electrification. The minimum bill required will be $3.60 per month.

Feed Grinder Operated by Portable Motor

Funds available from water power rentals are sufficient only to provide the necessary bonus for the present Manitoba Power Commission network and its postwar extensions. Farm electrification will require an additional sum of $526,000 per annum by the tenth year. The bonus per farm will be $21.00 per annum. Failure to obtain the necessary bonus funds would require a 10c, 4c, 2c three-block rate for farm service, with a net minimum bill of $4.50 per month.

Beyond the tenth year there will still be 15,000 potential farm customers, requiring an additional capital expenditure of $10,000,000 and additional bonus funds of $800,000 per annum.

It is recommended that the province make arrangements to supply farmers with standard packages of appliances as near as possible at net cost. Unless all other methods fail, it is not recommended that the province assume any financial liability with respect to the sale of appliances, but merely that it act as an agent between the manufacturer and farmer. The total cost of wiring and appliances for 25,000 farmers after ten years is estimated at $14,337,500.

Low-cost money and low cost of construction and appliances are essential to the success of comprehensive farm electrification. It is difficult to forecast exactly what the immediate postwar conditions will be, if low cost conditions do not prevail or are delayed, the findings and recommendations of this report are modified to that extent. (See Chapter I.)

APPENDIX A- CHAPTER IX

Report on Sample Study of 493 Manitoba Farms Not Being Served with Central Station Power

During July and August of 1948 the Commission conducted a survey of Manitoba farms not being served with central station power. Three investigators visited 493 farms located in seven municipalities. The seven municipalities were chosen with the aid and advice of the Manitoba Department of Agriculture. Within each municipality one township, six miles square, was chosen and each farm in the township was visited. These townships were considered representative of larger farming areas, representative from the point of view of density of settlement, income status, and type of farming. With very few exceptions the farmers visited were extremely co-operative, displaying great interest in the possibility of obtaining electric power.

Among the purposes of the survey the most important were those of securing definite information with respect to:

1. The attitude of Manitoba farmers to farm electrification.
2. Farmers' expenditures for services for which electricity is a substitute.
3. An estimate of income on Manitoba farms.
4. An estimate of the number of farmers per mile and hence of the approximate cost of extending farm lines.

The tables contained in this appendix are designed to throw some light on these questions. It is likely that the limited size of the sample will detract from the reliability of the results in certain particulars. This may be true especially of the income estimates and estimates.

The tables may be grouped together under several headings, as follows:

Tables 1 to 5 are mainly introductory, describing the sample in terms of the character sticks of the farm operator. These indicate the number of owners and tenants, the nationality and age of the farm operator, and the size of his family, all being factors which bear on the intensity of the desire for electric power.

Tables 6 to 10 indicate the types of farming practised by the farms included in the sample.

Tables 11 to 16 deal with questions that are germane to a consideration of the possibility of rural electrification. They indicate the methods by which farmers now obtain those services which electricity is able to perform: lighting, water supply, sewage disposal, and radio. This group of tables includes a complete summary of the extent to which these farmers now make use of private electric plants.

Tables 17 and 18 provide information on the availability of various items of farm equipment on the farms visited.

Table 19 shows the average distance of farm buildings from the road allowance. This is important as an indication of part of the cost of extending farm lines.

Tables 20 to 33 analyse the response of farmers to questions concerning their attitudes to electricity. Various cross-classifications are presented, with a view to suggesting differences in the farmer's attitude depending on his age, whether he is owner or tenant, and his income status.

Tables 34, 35 and 36 show the expenditures of farmers in the sample for services for which electricity may be considered a substitute.

Tables 37 and 38 record the estimated average incomes of farmers in the areas surveyed.

The remaining tables 39 to 53 present miscellaneous information with respect to farm buildings and the general condition of the farmstead.

Table 1—Number of Farms Surveyed by Municipality

Municipality	No.
Portage la Prairie	70
Grandview	70
Dufferin	60
Morton	55
Manitou	60
Rockwood	50
Rhineland	118
	493

TABLE 2. FARMS CLASSIFIED ACCORDING TO TENURE

Municipality	Operated by Owner	Operated by Tenant*	Unoccupied	Hired Manager	Not Given and Miscellaneous
Portage	65	12	1	1	
Grandview	49	24			5
DeSalaberry	36	6			
Morton	35	28			2
Hamiota	31	11	2		2
Rockwood	69	10			1
Rhineland	94	21			
	379	102	3	1	10

*Forty-one farms operated by tenants were owned by private individuals and 14 by mortgage companies. No information was obtainable for the rest.

TABLE 3. NATIONALITY OF FARM OPERATOR

Nationality	No.
English	104
Scotch	79
Irish	51
Ukrainian	29
French	33
German	132
Swedish	8
Dutch	7
Miscellaneous and not stated	52
	495

TABLE 4—AGE DISTRIBUTION OF FARM OPERATORS

Age	Portage	Grand-view	DeSala-berry	Morton	Hamiota	Rock-wood	Rhine-land	All
21-30	8	9	9	5	8	4	21	57
31-40	12	15	17	14	13	14	31	116
41-50	20	23	6	15	6	19	35	125
51-60	17	12	7	14	9	23	15	97
61 and over	20	12	8	9	11	19	10	84
Not stated	2	7	1		2	1	3	16

TABLE 5—SIZE OF FARM OPERATORS' FAMILIES

No. in Family	Portage	Grand-view	DeSala-berry	Morton	Hamiota	Rock-wood	Rhine-land	All
1	2	2		4		2	2	12
2	14	17	3	8	8	14	5	69
3	19	10	5	12	11	16	13	86
4	15	11	6	6	10	13	17	77
5	11	13	7	6	8	17	15	82
6	3	7	5	4	3	6	15	45
7	2	2	3	3		5	11	26
8	4	2	2	2	1	1	8	20
9		3	1	2	1		7	14
10	1		4				8	13
Over 10	2	1	5				12	20
Not stated	1	5	2	3	4	4	2	26

TABLE 6—TYPES OF FARMING ENGAGED IN

Type of Farming	Portage	Grand-view	DeSala-berry	Morton	Hamiota	Rock-wood	Rhine-land	Total
Mixed	28	67	39	25	34	74	113	375
Grain	46	1	..	28	6	2	1	84
Dairy				1	1	1		3
Stock Farm	.					.	2	2
Fur Farm				.	.	2		2
Miscellaneous and not stated	5	10	3	1	5	4	1	29

TABLE 7 FREQUENCY DISTRIBUTION OF FARMS ACCORDING TO SIZE

No. of Acres	Portage	Grand-view	DeSala-berry	Morton	Hamiota	Rock-wood	Rhine-land	Total
1 50						3	17	20
51–100		3	3			3	17	26
101 200	11	29	6	3	4	42	44	139
201–300	3	3	11			10	17	44
301 400	43	26	12	20	16	16	15	148
401 500	10	5	7	19	11	2	4	58
Over 500	9	3	3	13	12	4	1	50
Not stated	3	4		.	3			10

TABLE 8—ACREAGE SOWN TO WHEAT ON 341 MANITOBA FARMS

Acreage in Wheat	Portage (52 farms)	Grand-view (65 farms	DeSala-berry (13 farms)	Morton (50 farms)	Hamiota (36 farms)	Rock-wood (65 farms)	Rhine land (65 farms,	Total 341 farms)
1– 25	28	17	12		4	27	31	117
26– 50	14	25	5	4	12	6	36	100
51 75	6	13	1	4	7	1	10	42
76–100	5	7		13	5	1	4	35
101 200	1	3		21	8		4	37
201–300			.	6	1			9
301 400					1	.		1

TABLE 9 ACREAGE SOWN TO BARLEY ON 424 MANITOBA FARMS

Acreage in Barley	Portage (70 farms,	Grand view (60 farms	DeSala-berry (41 farms	Morton (51 farms)	Hamiota (37 farms)	Rock wood (65 farms	Rhine-land (100 farms	Total (424 farms
1– 25		22	3	4	1	23	25	76
26– 50	3	19	13	9	13	14	35	108
51 75	9	13	13	10	10	11	23	90
76–100	5	1	6	12	9	6	8	47
101 200	42	4	4	12	3	3	9	82
201–300	6	1		2	.	1		10
301 400	2			2	1	.		5
401–500	2							2
501–600	2							2

TABLE 10—NUMBER OF MILKING COWS ON 466 MANITOBA FARMS

No. of Cows	Portage (73 farms)	Grand-view (70 farms)	DeSale-berry (42 farms)	Morton (51 farms)	Hamiota (41 farms)	Rock-wood (75 farms)	Rhine-land (114 farms)	Total (466 farms)
5 and under	54	59	1	30	20	39	92	286
6– 10	16	18	16	17	17	32	22	138
11 15	3	2	14	3	4	4		30
16– 20			6	1				7
21 25			2					2
26– 30			1					1
More than 30			2					2

TABLE 11 NUMBER OF FARMS REPORTING USE OF ELECTRICITY FROM PRIVATE PLANTS

Municipality	Electricity Used in House	Barn	Other Buildings
Portage	13	9	7
Grandview	1	1	1
DeSalaberry	3	3	2
Morton	16	12	12
Hamiota	2	2	2
Rockwood	3	2	3
Rhineland	3	3	2
	41	32	29

TABLE 12—METHODS USED FOR SUPPLYING WATER ON 467 MANITOBA FARMS

Method	Portage	Grand view	DeSala-berry	Morton	Hamiota	Rock-wood	Rhine-land	All
Windmill	2	1		23	4	1	2	33
Gasoline engine	2		3	8	18	28		59
Hand pump	74	2	9	36	13	42	62	239
Dugout		5		13			93	111
Cistern	3		4	10	3	1	35	109
Well	1	56	56	45	38	77	10	283
Water under pressure	3		3	5	4	3		22
Miscellaneous		6	4					10

TABLE 13—METHODS OF SEWAGE DISPOSAL ON MANITOBA FARMS

Municipality	Septic Tank	Cesspool	Outdoor Toilet
Portage	4		73
Grandview			68
DeSalaberry		2	34
Morton		1	45
Hamiota	2	2	31
Rockwood		1	76
Rhineland			110
	6	6	437

TABLE 14—NUMBER OF FARMS REPORTING USE OF GASOLINE OR WIND ELECTRIC PLANTS Plants Classified According to Wattage, Voltage, Age, Condition, and Cost.

	Gasoline Plants	Wind Plants
Municipality		
Portage	11	4
Grandview	1	5
DeSaloberry	2	1
Morton	13	8
Hamiota	3	3
Rockwood	3	2
Rhineland	2	12
	35	30
Wattage		
Under 500	1	10
500- 750	9	2
750–1000	13	3
Over 1000	2	0
Not stated	5	15
	35	30
Voltage		
6 volts	4	19
16 volts		1
32 volts	30	10
Not stated	1	
	35	30
Age		
Under 5 years	2	19
5–10	4	7
10–15	8	
15–20	4	
Over 20	14	
Not stated	3	4
	35	30
Condition		
Excellent	2	2
Good	21	19
Fair	6	3
Poor	5	
Not stated	1	6
	35	30
Cost When New		
Under $100	3	20
100- 500	11	4
500–1000	13	4
Over 1000	2	2
Not stated	1	
	35	30

TABLE 15—METHOD OF LIGHTING ON MANITOBA FARMS

Municipality	Electricity	Kerosene	Gasoline
Portage	18	56	30
Grandview	1	69	9
DeSalaberry	3	38	5
Morton	16	41	10
Hamiota	2	37	1
Rockwood	3	67	14
Rhineland	3	106	2
	41	409	51

TABLE 16—NUMBER OF FARMS REPORTING RADIOS, CLASSIFIED ACCORDING TO TYPES

Municipality	A.C.	Battery	Not Used	Total
Portage	1	63	15	79
Grandview	4	48	26	78
DeSalaberry	1	21	20	42
Morton	1	48	6	55
Hamiota	1	37	8	46
Rockwood	1	41	38	80
Rhineland		48	67	115
	9	306	180	495

TABLE 17—NUMBER OF FARMS REPORTING VARIOUS ITEMS OF FARM EQUIPMENT AND TELEPHONES

Municipality	No. of Farms Surveyed	Combine	Thresher	Tractor	Truck	Auto-mobile	Tele-phone
Portage	79	28	22	66	29	70	62
Grandview	78		10	29	4	44	20
DeSalaberry	42	3	9	20	13	13	16
Morton	55	4	24	41	22	49	38
Hamiota	46	5	16	30	3	39	36
Rockwood	80	3	13	30	13	47	22
Rhineland	115	2	22	66	12	75	2
	495	40	118	291	106	342	196

TABLE 18—NUMBER OF FARMS REPORTING GASOLINE ENGINES; FARMS CLASSIFIED ACCORDING TO NUMBER OF ENGINES REPORTED

	Portage	Grand-view	DeSala-berry	Morton	Hamiota	Rock-wood	Rhine-land	All
No of farms interviewed	79	78	42	55	46	80	115	495
No. reporting engines	55	30	28	30	33	39	46	249
1	35	14	20	20	24	33	34	180
2	14	6	4	7	8	5	13	57
3	3		2	2		1	1	9
4	1			1	1			3
Total engines reported	70	26	34	44	44	46	63	333

TABLE 18—CONTINUED

Horsepower Capacity	GASOLINE ENGINES CLASSIFIED ACCORDING TO SIZE	
	No.	*Per Cent*
Under 1	105	32.6
1 and under 2	114	35 5
2 and under 3	32	10. 0
3 and under 4	29	9 0
4 and under 5	7	2 2
5 and under 10	28	8. 7
10 and over	6	2 0
	321	100 0

TABLE 19—AVERAGE DISTANCE OF BUILDINGS FROM ROAD ALLOWANCE

Municipality	Average Distance (in feet)
Portage	383
Grandview	423
DeSalaberry	208
Morton	602
Hamiota	640
Rockwood	476
Rhineland	541
All	474
All except DeSalaberry*	499

*Since farms in DeSalaberry were mainly of the river lot type, the average distance from road allowance is not typical of the majority of farms in the province

TABLE 20—ATTITUDE TO ELECTRICITY EXPRESSED BY 468 MANITOBA FARMERS

Attitude	Portage	Grand view	DeSala-berry	Morton	Hamiota	Rock-wood	Rhine-land	All
Anxious	45	19	21	47	30	35	67	265
Interested	11	18	19	4	6	28	32	118
Might consider	8	21	1		2	7	8	47
Indifferent	5	15	1	2	2	5	2	33

TABLE 21—ATTITUDE OF FARMER TO ELECTRICITY, WITH OPERATORS CLASSIFIED ACCORDING TO FARM TENURE

Attitude	Owners	Tenants
Anxious	57%	55%
Interested	26	27
Might consider	10	10
Indifferent	7	8

TABLE 22—ATTITUDE OF FARMER TO ELECTRICITY, WITH OPERATOR CLASSIFIED ACCORDING TO AGE

Attitude	21-30 Yrs	31-40 Yrs	41-50 Yrs	51-60 Yrs	61 Yrs and Over
Anxious	57%	70%	53%	57%	47%
Interested	30	22	25	27	27
Might consider } Indifferent }	13	8	22	16	26

TABLE 23—ATTITUDE OF FARMER TO ELECTRICITY, WITH OPERATORS CLASSIFIED ACCORDING TO REPORTED GROSS FARM INCOME

Income	Anxious	Interested	Might Consider	Indifferent	Not Stated
$ 1-$ 500	3	3	3	5	1
500- 1,000	23	20	7	5	3
1,000- 1,500	29	27	9	4	2
1,500- 2,000	42	10	5	5	
2,000- 3,000	50	13	5	1	4
3,000 and over	61	3	1	1	9
	244	86	87	21	19

TABLE 24—AVERAGE ANNUAL EXPENDITURE ON 478 MANITOBA FARMS FOR SUBSTITUTES FOR ELECTRICITY

Substitute	Portage	Grand-view	DeSala-berry	Morton	Hamiota	Rock-wood	Rhine-land	All
Fuel for lighting	$ 9 99	$ 8 50	$ 9 76	$ 7 97	$ 9 63	$11 67	$ 7 08	$ 9 07
Fuel for power	11 77	5 38	8 15	8 91	20 35	16 58	3 74	11 54
Cost of private plant	92 71	15 30	114 33	85 11	77 14	56 75	25 56	74 93
Fuel for cooking	42 96	26 19	32 00	28 67	44 92	37 89	22 72	32 36
Ice	5 50	10 61		5 50	4 96	15 75	4 50	7 60
Radio battery	12 01	10 88	12 85	10 46	13 50	10 85	8 82	11 08

AVERAGE ANNUAL COST FOR SUBSTITUTES FOR ELECTRICITY ON FARMS WITH AND WITHOUT PRIVATE PLANTS

No private electric plant.		
Lighting only	$ 9 07	
Lighting and fuel for power (stationary gasoline engines)	20 61	
Lighting, power, and cooking	52 97	($ 31 39)*
Lighting, power, cooking, and radio	64 08	(42 47)
Lighting, power, cooking, radio, and ice	71 68	(50 07)
Private electric plant.		
Lighting (where private plant is used) and cooking	107 84	(85 76)
Lighting, cooking, and power (stationary gasoline engines)	118 98	(97 30)
Lighting, cooking, power, and ice	126 48	(104 20)

*Figures in parentheses include only one-third of the cooking costs, those for the summer months.

TABLE 25—FREQUENCY DISTRIBUTION OF AVERAGE ANNUAL EXPENDITURE FOR SUBSTITUTES FOR ELECTRICITY ON 478 MANITOBA FARMS

Expenditure	Portage	Grand-view	DeSala-berry	Morton	Hamiota	Rock-wood	Rhine-land	All
$ 1-$ 24.99	1	1	5	2		1	31	41
25- 49.99	10	33	21	16	1	24	55	163
50- 74.99	33	24	6	17	14	33	19	156
75- 99.99	7	4	3	6	14	11	6	51
100- 124.99	9	1	4	4	3	4	1	26
125- 149.99	4		1	4	4	5	-	18
150- 199.99	6		1	6	5	1	,	17
200 and over	4		1			1		6
	74	73	42	55	39	80	115	478

TABLE 26—AVERAGE ANNUAL COST OF PRIVATE ELECTRIC PLANTS ON 50 MANITOBA FARMS (AS REPORTED)

Item	Cost
Depreciation	
Plant	$38.05
Batteries	20.15
Maintenance	6.06
Operation	28.41
Average (all farms)	$74.98

TABLE 27—AVERAGE GROSS FARM INCOME FOR CROP YEAR 1941-42 ON 377 MANITOBA FARMS

Municipality	Crops	Livestock	Livestock Products	Miscellaneous	All Sources
Portage	$1,946	$745	$185	$180	$3,056
Grandview	544	459	163	312	1,478
DeSalaberry	784	574	895	150	2,473
Morton	2,002	492	274	350	3,118
Hamiota	2,127	604	355	248	3,334
Rhineland	978	472	214	192	1,856
All farms	$1,312	$558	$296	$234	$2,101

Data for Rockwood has not been included, as information obtained in this municipality was not considered accurate by the local agricultural representative.

TABLE 28—SIZE OF GROSS INCOME FOR 1941-42 ON 377 MANITOBA FARMS

Gross Income	Portage	Grand-view	DeSala-berry	Morton	Hamiota	Rhine-land	All
$ 1-$ 500		14		1		8	23
500- 1,000	5	22	6	2		25	59
1,000- 1,500	5	13	7	5	6	31	72
1,500- 2,000	13	5	5	9	7	14	61
2,000- 3,000	19	6	12	16	9	23	85
3,000 and over	20	3	9	18	14	13	77
	67	63	41	51	36	114	377

TABLE 29—CONDITION OF FARM BUILDINGS

Condition of Building	Portage	Grand-view	DeSala-berry	Morton	Hamiota	Rock-wood	Rhine-land	All
House:								
Painting badly needed	44	48	16	15	15	33	42	213
Fair	22	21	15	10	16	24	35	143
Good	9	6	10	30	12	15	25	107
Not stated	4	3	1		3	3	13	27
Other Buildings:								
Painting badly needed	47	53	25	17	23	52	52	269
Fair	21	16	11	21	11	17	30	127
Good	6	5	4	17	3	6	21	67
Not stated	5	4	2		4	5	12	32

TABLE 30—GENERAL CONDITION OF FARMSTEAD

Condition of Farm	Portage	Grand-view	DeSala-berry	Morton	Hamiota	Rock-wood	Rhine-land	All
Neat	9	3	4	16	13	5	26	78
Well-kept	18	10	5	16	6	21	25	101
Average	34	46	23	18	22	39	41	223
Bad	13	11	6	2	2	7	13	52
Excessive debris		1		1				2
Not stated	5	7	4		3	8	12	39

TABLE 31—NUMBER OF HOUSES AND NUMBER OF ROOMS PER HOUSE

Unit	Portage	Grand-view	DeSala-berry	Morton	Hamiota	Rock-wood	Rhine-land	All
No. of houses	79	78	43	56	46	82	113	497*
No. of rooms:								
5 and under	11	50	24	14	13	40	78	230
6	18	10	6	11	9	12	14	75
7	13	5	1	6	3	7	10	50
8	11	6	4	10	6	7	4	48
9	11	1	3	5	6	4	1	31
10	3	1	3	3	1	1	3	20
Over 10	9	1	1	7	1	1	1	21
Not stated	3	4	1		3	10	2	22

*Several farms reported more than one house

TABLE 32 NUMBER AND TYPE OF FARM BUILDINGS

Building	Portage	Grand-view	DeSale-berry	Morton	Hamiota	Rock-wood	Rhine-land	All
Barn	69	62	44	52	42	78	115	460
Silo			2	1	1	2	2	8
Cattle shed	9	8	3	2	1	8	2	23
Hay shed			9		5	1		15
Milk house	3	1	26	3	5	15	8	61
Poultry house	60	54	53	48	35	68	109	469
Hog house	35	32	26	22	27	36	74	254
Grain storage	58	61	94	97	105	72	98	585
Machine shed	1		21	29	16	10	52	129
Other buildings	35	18	23	25	35	29	47	213

TABLE 33—LANDSCAPE FEATURES AND CONDITION OF LAWN

	Portage	Grand-view	DeSale-berry	Morton	Hamiota	Rock-wood	Rhine-land	All
Landscape features								
Windbreaks	69	51	7	45	37	76	91	376
Shade trees	61	37	17	46	28	39	80	308
Lawns	38	11	5	25	20	51	22	172
House fenced from livestock	49	15	10	23	24	36	30	189
Shrubs	49	12	2	33	25	23	32	174
Flowers	42	25	5	26	26	27	47	198
Orchards	9	3	5	17	4	23	48	109
Garden	68	71	31	48	38	79	88	423
Yard or garden irrigated	1		3		1	2		7
Condition of lawn								
Good	21	3	1	5	0	17	2	58
Fair	12	2	1	1	4	19	7	46
Poor	1	2	1			1		5
Excellent	1	-	-		1			2
Not stated	3	4	2	19	6	14	13	61

APPENDIX B—CHAPTER IX

Report on Questionnaire Submitted to Minnesota and North Dakota R.E.A. Co-operatives, August, 1942

The tables included in this appendix were compiled from information obtained by means of a questionnaire submitted to R.E.A. co-operatives in Minnesota and North Dakota. Questionnaires were sent to 40 co-operatives in Minnesota and to 6 in North Dakota. A total of 34 replies were obtained, though in some cases not all questions were answered.

The co-operatives that answered the questionnaire represent a total of 37,517 farm members and account for 20,056 miles of line in the two states. According to the latest annual report of the R.E.A. there were 64,000 farms in Minnesota and North Dakota receiving central station electric service on June 30, 1941. The information contained in the following tables, therefore, covers 60% of all electrified farms, which may be considered to constitute a representative sample.

The facts and figures reported in these tables are significant for a Manitoba farm electrification programme. All of the United States co-operatives for which data were secured are regarded by the R.E.A. as successful. Yet it will be noted that Table 1 shows more than half of the local co-operatives have only two customers per mile of line or less.

Table 1. Average Number of Members per Mile of Line

No. of Members per Mile of Line	No. of Co-ops. Reporting	No. of Members per Mile of Line	No. of Co-ops. Reporting
1·26–1·50	3	3·01–3·25	1
1·51–1·75	3	3·26–3·49	
1·76–2·00	7	3·50–3·75	1
2·01–2·25	5	3·76–4·00	
2·26–2·49	6	4·01–5·00	1
2·50–2·75	1		—
2·76–3·00	1		34

Table 2 shows that over 80% of the farmers within 1,000 feet of existing lines signed up for energy in the case of 19 co-operatives out of 34.

Table 2. Percentage of Farmers Within 1,000 Feet of Existing Lines Who Signed Up for Energy

Per Cent Signing Up	No. of Co-ops Reporting
50– 60	3
61– 70	4
71– 80	5
81– 90	13
90–100	4
Not stated	3
	34

Table 3 reveals that tenant farmers demonstrated their desire for electric power by signing up for energy in almost as great proportion as farmers as a whole.

TABLE 3—PERCENTAGE OF TENANT FARMERS WITHIN 1,000 FEET OF EXISTING LINES WHO SIGNED UP FOR ENERGY

Per Cent Signing Up	No. of Co-ops. Reporting
50 or less	5
51– 60	2
61– 70	2
71– 80	7
81– 90	10
91–100	3
Not stated	5
	34

*Tables 4 and 5 show that farmers who had experienced the advantages of electric power through their own wind or gasoline charger plants were even more ready to sign up for energy from a central station than were farmers as a group.

TABLE 4—PERCENTAGE OF FARMERS WITH WIND ELECTRIC PLANTS WHO SIGNED UP FOR ENERGY

Per Cent Signing Up	No. of Co-ops Reporting
50 or less	3
51– 60	1
61– 70	
71– 80	3
81– 90	4
91–100	19
Not stated	4
	34

TABLE 5—PERCENTAGE OF FARMERS WITH GASOLINE ELECTRIC PLANTS WHO SIGNED UP FOR ENERGY

Per Cent Signing Up	No. of Co-ops. Reporting
50 or less	1
51– 60	
61– 70	
71– 80	4
81– 90	4
91–100	21
Not stated	4
	34

Tables 6, 7, and 8 demonstrate that electricity consumption tends to increase as the length of the period in which the farm has been electrified increases. In order to show this, it was necessary to consider only those co-operatives whose experience covered at least four years. This phenomenon of increased utilization is indicated in three different ways a decrease in the proportion of members having minimum bills, the size of monthly bills, and consumption in kilowatt hours.

The significance of Table 6 may best be understood by noting the number of co-operatives in which more than 50% of the members had minimum bills after the lines had been energized for various periods. After six months 6 co-operatives fell into this group; after

one year, the number was reduced to 4 co-operatives, after two years to 2 co-operatives, and after three years only 1 co-operative reported that more than 50% of its members had minimum bills. After the line had been energized for four years no co-operative had more than 50% of customers with minimum bills

A similar tendency is apparent from Tables 7 and 8. As the length of the period increases during which electricity has been used, the average size of the bill and the average consumption increase.

TABLE 6—PERCENTAGE OF MEMBERS OF 15 CO-OPERATIVES WITH MINIMUM BILLS AFTER VARIOUS PERIODS

Per Cent with Minimum Bills	Line Energized for				
	6 Mos.	1 Yr.	2 Yrs.	3 Yrs.	4 Yrs.
20 and under	1	2	2	4	6
21- 30	4	1	8	2	3
31- 40	3	3	6	3	5
41- 50	1	5	2		1
51- 60	4	3	1	1	
61- 70			1		
71- 80	1	1			
81- 90	1				
91-100					
	15	15	15	15	15

TABLE 7—AVERAGE MONTHLY ELECTRIC BILL OF MEMBERS OF 14 CO-OPERATIVES AFTER VARIOUS PERIODS

Size of Bill	Line Energized for				
	6 Mos.	1 Yr	2 Yrs	3 Yrs	4 Yrs
$2 00-$2 49					
2 50- 2 99	1				
3 00- 3 49		1	1		
3 50- 3 99	4	1	2	1	1
4 00- 4 49	4	7	5	3	1
4 50- 4 99	4	1	1	5	5
5 00- 5 49	1	4	4	2	4
5 50- 5 99			1	3	3
	14	14	14	14	14

TABLE 8—AVERAGE MONTHLY CONSUMPTION OF MEMBERS OF 14 CO-OPERATIVES AFTER VARIOUS PERIODS

Kwhr Consumed	Line Energized for				
	6 Mos.	1 Yr.	2 Yrs.	3 Yrs.	4 Yrs
30- 39 9	2	1			
40- 49 9	3	3	2	2	1
50- 59 9	7	7	6	1	1
60- 69 9	2	2	4	3	3
70- 79 9		1	2	5	6
80- 89 9				2	3
90- 99 9				1	3
100-109 9					
110-119 9					1
	14	14	14	14	14

Table 9 shows the preference rating for electric appliances in both home and barn operations. Several co-operatives reported more than one appliance

TABLE 9—FIRST APPLIANCE INSTALLED AFTER LIGHTING

Appliance	No. of Co-ops. Reporting
Home Appliances	
Washers	19
Iron	14
Radio	10
Refrigerator	5
Farm Appliance	
Motor for pumping	28
Cream separator	2
Not stated	4

Tables 10 and 11 suggest that delinquencies in energy or appliance bills are not a serious problem, 10 co-operatives report no delinquencies, 16 co-operatives report 2% or less of their members delinquent in meeting these bills.

TABLE 10—PERCENTAGE OF MEMBERS DELINQUENT IN BUILDING WIRING OR APPLIANCE BILLS, AUGUST, 1942

Per Cent Delinquent	No. of Co-ops. Reporting
00	10
01–2	16
2 01–4	3
4 01–6	2
Not stated	5
	34

TABLE 11—PERCENTAGE OF MEMBERS WHOSE POWER WAS SHUT OFF DEC. 31, 1941, BECAUSE OF DELINQUENCIES

Per Cent	No. of Co-ops Reporting
00	28
01–1	4
1 01–2	1
Not stated	1
	34

Eighty per cent of R.E.A. co-operatives require that members read their own meters, and a growing number also require that they bill themselves at the same time. The savings in this connection are reported in Tables 12 and 13.

TABLE 12—SAVING PER MEMBER PER MONTH THROUGH SELF-METER READING

Savings per Month	No. of Co-ops. Reporting
1c– 5c	4
6c– 10c	12
11c–15c	4
16c–25c	2
26c–35c	1
36c–50c	2
Not stated	9
	34

TABLE 13.—SAVINGS PER MEMBER PER MONTH THROUGH SELF-BILLING (11 CO-OPERATIVES)

Savings Per Month	No. of Co-ops. Reporting
1c– 5c	5
6c–10c	4
11c–15c	1
15c–25c	1
	11

In some cases the co-operatives have been able to secure non-farm customers, who usually buy large quantities of energy. The sales to such customers are reported in Table 14. These revenues help to carry the overhead.

TABLE 14—PERCENTAGE OF ANNUAL ENERGY REVENUE DERIVED FROM NON-FARM BUSINESS

Per Cent of Revenue	No. of Co-ops. Reporting
1–14 0	15
15–29 9	7
30–44 9	3
45–59 0	1
60 and over	4
Not stated	6
	34

Table 15 shows that the median price paid by the thirty-four co-operatives for energy which they bought was about 1·25c per kwhr. Inevitably transformers, meters, and lines absorb some of this energy, after taking account of such line losses, the average cost of energy actually sold by the co-operative was about 1·75c per kwhr. This may be seen by the figures presented in Table 16.

TABLE 15—COST PER KWHR OF ELECTRIC ENERGY PURCHASED BY CO-OPERATIVES

Cost per Kwhr	No. of Co-ops. Reporting	Cost per Kwhr	No. of Co-ops. Reporting
1·00c–1·10c	2	1·61c–1·70c	2
1·11c–1·20c	3	1·71c–1·80c	
1·21c–1·30c	7	1·81c–1·90c	1
1·31c–1·40c	5	1·91c–2·00c	1
1·41c–1·50c	3	Not stated	3
1·51c–1·60c	2		34

TABLE 16—COST PER KWHR OF ELECTRIC ENERGY SOLD BY CO-OPERATIVES AFTER ALLOWING FOR LINE LOSSES

Cost per Kwhr	No. of Co-ops. Reporting	Cost per Kwhr	No. of Co-ops. Reporting
1·31c–1·40c	3	2·01c–2·10c	1
1·41c–1·50c	1	2·11c–2·20c	3
1·51c–1·60c	6	2·21c–2·30c	
1·61c–1·70c	5	2·31c–2·40c	1
1·71c–1·80c	3	Not stated	3
1·81c–1·90c	3		34
1·91c–2·00c	3		

APPENDIX C—CHAPTER IX

Report on Survey of All Farms in the Province of Manitoba Receiving Central Station Power in 1942

In June 1942, the Manitoba Electrification Enquiry Commission submitted a questionnaire to occupants of all farms in the province served with central station power. The forms were filled out mainly on the farms by representatives of the several utilities. Information with respect to revenue and consumption was supplied by the head offices of the several utilities.

The tables accompanying this report were compiled by tabulating the data contained in the questionnaires. Throughout it was considered desirable to classify the farms according to the utility supplying power, thus yielding information separately for each of the following utilities:

1. The Manitoba Power Commission
2. The Winnipeg Electric Company (including subsidiaries)
3. The Winnipeg Hydro (including farmers supplied by the town of Brunkhurst)
4. Others (including several municipal systems and the National Utilities Corporation)

Tables 1 to 3 indicate the number of electrified farms in the province and the proportion of farms served by each utility. They also supply information with respect to the conditions of the buildings, farm tenure, types of farming, and the number of years the farm has been connected to electric power lines.

There are 1 100 farms in the province of Manitoba receiving central station service. The Dominion Census of 1941 reports 56,000 farms in Manitoba, so approximately 1.96% of Manitoba farms are electrified. The accuracy of this figure and the degree of comparability with figures for the United States will of course depend on the definition of a farm. The census figure used above includes any tract of land one acre or more in extent and which has produced in 1940 agricultural products to the value of $250 or more. For the Commission's questionnaire, "an abode of a person earning his livelihood from farm activities" was classed as a farm, but all tracts under five acres were eliminated. Since the census figure includes smaller farms than those considered for purposes of the present survey, the above percentage of electrified farms may be somewhat lower than is actually the case. Despite this difference in definition, it is probable that the percentage of electrified farms as shown by the following data cannot be very far off.

One half of the farms now electrified receive their power from the Manitoba Power Commission. The Winnipeg Electric Company serves approximately 40%, and 6% are supplied by the Winnipeg Hydro.

Slightly over 90% of electrified farms are operated by the owner, while 7.6% of the farmers are tenants. Of the Manitoba Power Commission customers, 94% are owners, 4.8% are tenants.

Almost 80% of the operators of electrified farms are described as being engaged in mixed farming. The proportion of mixed farms among farm customers of the Manitoba Power Commission is well over 80%.

Prior to 1936 the largest number of farms connected by the Manitoba Power Commission in any one year was 97. During the depression years 1930 to 1937 only 31 farms were connected. In the two years preceding the outbreak of war, however, the Commission connected 300 farms.

Tables 4 to 14 are designed to provide information with respect to net revenue, consumption, and average rates per kwhr. The various utilities were asked to fill in this information for the calendar year 1941, though this practice was not followed in every case, the Manitoba Power Commission records being for the commission's fiscal year 1941. In each case, however, the schedule analyzed covered a recent twelve month period. The schedules for those farms that have been connected for less than one year were eliminated, leaving a total of 981 records for the analyses of revenue, consumption and average rates, data not being supplied for all questions in every case.

In trying to determine averages for the province as a whole and for the various utilities separately, the question arose as to the type of average to use. It was decided wherever possible to make calculations both of the arithmetic mean and of the median. Each of these

Two types of average may be considered significant for different purposes in the present analysis. In the arithmetic mean [illegible] large figures exercise an influence out of proportion to their frequency of occurrence. [illegible] of revenue and consumption on the typical farm after rural electrification has been extended, it [illegible] preferable to use the median.

The median [illegible] is a measure of typical revenue and consumption.

Another reason for using the median in the present analysis is that [illegible] revenue and consumption include the use of water heaters. [illegible] median eliminates the influence of these cases to a major extent.

Tables [illegible] and [illegible] average revenue, consumption and rate per kwhr. The averages [illegible] are arithmetic means. *Table* [illegible] shows average rates per kwhr calculated by each of the two methods. It will be noted that the median rates are higher throughout. The lower rates per kwhr shown when the arithmetic mean is used are due to the influence of large consumers.

Table [illegible] indicates that for all districts average revenue is greatest on [illegible] farms served by the Manitoba Power Commission the consumption of electricity was lowest on grain farms and on market garden farms.

In *Tables* [illegible] and [illegible] revenue, consumption and average rates [illegible] farms are broken down into various groups. From these tables medians have been [illegible] noted that [illegible] consumption per farm are [illegible] when the arithmetic mean is used.

In *Tables* [illegible] an attempt has been made to [illegible] the degree of correlation that exists between the number of years that the farmer has used electrical service and the [illegible] consumption and average rate [illegible] service on the [illegible] The degree of [illegible] indicated by [illegible] may be attributed to the fact that during some of the years between [illegible] and [illegible] depression during the period indicated [illegible]

These [illegible] Power Commission customers who had been connected [illegible] four years. [illegible] medians were calculated [illegible] Tables [illegible] and [illegible]

Tables 15 and 16 show the number of farms reporting motors and the uses and [illegible] to which the motors are being put. [illegible] electric motors. [illegible] in size. Pumping water was the major use to which motors were put.

Table [illegible] shows the number and proportion of farms that reported using various appliances. [illegible] these saturation figures with those for the Ontario Hydro reveals considerable similarity.

Table 18 shows the extent to which farmers acquire electrical appliances in relation to the number of years they have used electricity. A slight indication of the expected tendency is to be noted, particularly in the case of refrigerators, but the correlation is by no means striking. This fact is partly due to the high price of appliances.

Table 20 shows the electrified farms of Manitoba classified according to the basis of service. Three hundred and eighty farms, or 34% of all electrified farms, have separate transformers, while 719 farms, or 66%, are connected directly to a rural secondary line. Of those that have separate transformers some 60% reported having 5-K.V.A. transformers. The second most common size of transformer was the 3-K.V.A. Fifteen farm customers of the Manitoba Power Commission use 1½-K.V.A. transformers.

Forty-one per cent of those having no separate transformers were connected to distribution lines of towns and villages, while 59% were connected to rural secondary lines.

Table 21 shows that 70% of all farms reported having both residence and outbuildings wired, while 27% reported having only the residence wired.

TABLE 1—NUMBER OF FARMS WITH CENTRAL STATION SERVICE

Utility	No.	Per cent
Manitoba Power Commission	561	50 5
Winnipeg Electric Company	438	39 5
Winnipeg Hydro	89	8 1
Other utilities	21	1 9
	1,109	100

TABLE 2—TYPES OF TENURE ON FARMS SUPPLIED BY THE VARIOUS UTILITIES

Tenure	Man Power Comm.	Winnipeg Elec Co.	Winnipeg Hydro	Others	Total
Owners	527	385	80	19	1,011
Tenants	28	46	9	2	84
Managers	1				1
Not given	5	7	1		13
	561	438	89	21	1,109
Percentage of owners	94 0	87 9	89 9		91 1
Percentage of tenants	4 8	10 5	9 0		7 6

TABLE 3—CONDITION OF FARM BUILDINGS

Condition	No.	Per cent
Good	616	56
Fair	410	37
Poor	48	4
Not given	35	3
	1,109	100

TABLE 4—FARMS CLASSIFIED ACCORDING TO TYPE OF FARMING ENGAGED IN

Type of Farming	Man. Power Comm.	Winnipeg Elec. Co.	Winnipeg Hydro	Others	Total
Mixed	467	128	36	15	645
Market garden	25	117	7	1	150
Dairy	14	51	12	1	78
Stock	5	3	1		9
Poultry	3	37	2		42
Grain	22	19	9	3	53
Fur	5	59	15	1	80
Miscellaneous	17	27	4		48
Not given	3	..	1		4
	561	439	89	21	1,109

TABLE 5—FARMS CLASSIFIED ACCORDING TO NUMBER OF YEARS OF SERVICE

No. of Years Connected	Utility				
	Man. Power Comm.	Winnipeg Elec. Co.	Winnipeg Hydro	Others	All
(1942) Less than 1	67	20	1	3	91
(1941) 1	23	52	4	2	66
(1940) 2	57	35	2	2	96
(1939) 3	116	30	1	2	149
(1938) 4	164	34	1	4	203
(1937) 5	37	23	5	2	67
(1936) 6	9	44	3	1	57
(1935) 7	5	9	2	1	17
(1934) 8	4	9	6		19
(1933) 9	2	10	3		15
(1932) 10		21	4		25
(1931) 11	2	24	2		28
(1930) 12	2	21	1		24
(1929) 13	22	10	2		34
(1928) 14	5	10	3	1	19
(1927) 15	19	4	3		26
(Prior to 1927) More than 15	26	102	46	3	177
Not given	6	..			6
	561	439	89	21	1,109

TABLE 6—AVERAGE RATE PER KWH CHARGED BY THE VARIOUS UTILITIES

Utility	Arithmetic Mean	Median
Manitoba Power Commission	4.07c	7.88c
Winnipeg Electric Company	2.01	3.30
Winnipeg Hydro	1.51	2.51
Other utilities	9.61	-
All utilities	2.67c	5.37c

TABLE 7. AVERAGE REVENUE AND AVERAGE CONSUMPTION FOR A TWELVE-MONTH PERIOD ON VARIOUS TYPES OF FARMS

Type of Farming	Man. Power Comm.		Winnipeg Elec. Co.		Winnipeg Hydro		All Utilities	
	Rev	Cons. (kwhr)	Rev	Cons. (kwhr)	Rev	Cons. (kwhr)	Rev	Cons. (kwhr)
Mixed	$45 02	905	$47 56	1,529	$72 34	5,260	$47 62	1,311
Market garden	23 70	306	34 32	1,494	29 59	2,571	32 24	1,537
Dairy	52 01	1,406	82 49	5,686	66 65	4,566	74 30	4,642
Stock	40 43	637	39 74	3,027	53 56	2,050	42 39	1,496
Poultry	42 05	819	33 78	1,444	71 11	5,225	36 40	1,525
Grain	36 04	461	29 15	726	32 55	1,914	34 21	825
Fur	54 31	1,101	48 93	2,746	67 65	5,935	52 70	2,876
All Types	$44 62	597 2	$50 31	2,502	$61 94	4,093	$48 63	1,820

TABLE 8—ARITHMETIC MEAN OF RATE PER KWHR FOR A TWELVE-MONTH PERIOD ON VARIOUS TYPES OF FARMS

Type of Farming	Man. Power Comm	Winnipeg Elec. Co.	Winnipeg Hydro	Other Utilities	All Utilities
Mixed	4 97c	3 11c	1 37c	9 05c	3 68c
Market garden	7 78	2 30	1 15	8 33	2 41
Dairy	3 70	1 45	1 45	7 50	1 60
Stock	5 89	1 31	2 61		2 50
Poultry	5 14	2 34	1 51		2 36
Grain	8 25	4 01	1 69	17 65	4 16
Fur	4 93	1 78	1 70	10 00	1 83
Miscellaneous	3 58	1 53	2 69		1 83
Not given	6 77		6 45		6 55
All types	4 97c	2 01c	1 51c	9 61c	2 67c

TABLE 9—FREQUENCY DISTRIBUTION OF NET REVENUE OF THE VARIOUS UTILITIES FOR A TWELVE-MONTH PERIOD

Net Revenue	Man. Power Comm	Winnipeg Elec. Co.	Winnipeg Hydro	Other Utilities	All Utilities
$ 0–$ 9 99	5	15	6		26
10– 19 99	30	92	13		175
20– 29 99	86	91	25	2	214
30– 39 99	66	69	6	4	147
40– 49 99	46	22	9	3	80
50– 59 99	109	15	8	1	136
60– 69 99	35	24	3	3	65
70– 79 99	18	11	0	2	31
80– 99 99	10	21	1		32
100– 119 99	12	7	2		21
120– 139 99	1	9	5		15
140– 159 99	2	9	1		12
160– 179 99	3	5	1		9
180– 199 99	3	2	0	1	4
200 and over	2	7	6		15
	486	392	88	16	982
Median	$39 46	$31 22	$30 62		$35 10

TABLE 10—FREQUENCY DISTRIBUTION OF CONSUMPTION FOR THE VARIOUS UTILITIES FOR A TWELVE-MONTH PERIOD

Consumption	Man. Power Comm.	Winnipeg Elec. Co.	Winnipeg Hydro	Other Utilities	All Utilities
0— 99 kwhr	5	3	2		10
100— 199	70	19	1	1	91
200— 299	129	30	4	4	176
300— 399	40	36	5	2	81
400— 499	18	38	4	5	65
500— 599	16	24	5	2	47
600— 699	8	20	8		36
700— 799	17	17	0		34
800— 899	16	12	8		36
900— 999	20	12	4		36
1,000—1,099	24	9	3	1	37
1,100—1,199	20	12	1		33
1,200—1,299	14	6	2		22
1,300—1,399	11	5	3		19
1,400—1,499	2	6	2		10
1,500—1,599	9	6	1		16
1,600—1,699	3	5	2		10
1,700—1,799	3	4	1		8
1,800—1,899	6	5	1		12
1,900—1,999	6	3	3		12
2,000 and over	49	111	30	1	171
	486	392	88	16	982
Medians (kwhr)	398*	808	1,274		650

*This means that half the farmers used under 398 kwhr for the year

TABLE 11—FREQUENCY DISTRIBUTION OF RATES PER KWHR CHARGED BY THE VARIOUS UTILITIES FOR A TWELVE-MONTH PERIOD

Rate Per Kwhr	Man. Power Comm.	Winnipeg Elec. Co.	Winnipeg Hydro	Other Utilities	All Utilities
0c— 99c.		22	9		31
1 — 1 99		73	24		97
2 — 2 99	26	59	22		107
3 — 3 99	51	84	22		157
4 — 4 99	51	14	1		66
5 — 5 99	45	35	7	1	88
6 — 6 99	23	32	2		57
7 — 7 99	53	42		3	98
8 — 8 99	47	16		4	67
9 — 9 99	22	8	1	3	34
10 — 11 99	54	4		4	62
12 —13 99	64	1			65
14 —15 99	87	1			88
16 —19 99	12	1		1	14
20 and over	1				1
	486	392	88	16	982
Medians (kwhr)	7 88c	3 50c	2 51c		5 37c

TABLE 12—FREQUENCY DISTRIBUTION OF NET REVENUE OF ALL UTILITIES FROM FARM CUSTOMERS FOR A 12-MONTH PERIOD CLASSIFIED ACCORDING TO NUMBER OF YEARS OF SERVICE

Net Revenue	Number of Years of Service																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Over 15	Not Given	Total
$ 0-$ 9 99	6	9		9		5	1		1	1		1	1			5		26
10- 19 99	13	18	16	56	8	6	6	9	2	6	7	4	3	3		24		175
20- 29 99	7	23	24	60	9	16	2	5	4	4	9	6	7	4	1	34	1	214
30- 39 99	4	20	24	13	7	11	4	2	1	5	5	5	2	4	2	26	1	147
40- 49 99	2	7	11	13	7	2	2	6	3	1	3	2	4	2	2	13		80
50- 59 99	1	6	35	30	10	5		1	1	1			9		3	25	4	136
60- 69 99	1	3	13	11	5	4	1	1		2	4	2	1	1	7	4		65
70- 79 99		2	2	3	2	2	1	1			1	1	4		4	3		31
80- 99 99	1		3	4	3	2		2		3	1	2		2	1	8		32
100-119 99	1		4		2				1			3	1	2	1	6		21
120-139 99		3	1		1	1				1					1	7		15
140-159 99		3	3		1	1				1						3		12
160-179 99			1	3		1			1							3		9
180-199 99		2		1	1													4
200 and over			2		1			1					2	1		8		15
Total	86	94	149	201	57	57	17	20	14	25	28	24	34	19	27	174	6	982
Medians	$19.59	$30.00	$40.90	$27.16	$47.13	$50.00	$39.99	$44.16	$54.96	$33.99	$26.32	$34.99	$50.55	$37.49	$61.42	$31.72		

TABLE 13 FREQUENCY DISTRIBUTION OF FARM CONSUMPTION OF ELECTRICITY FROM ALL UTILITIES OVER A 12-MONTH PERIOD, CLASSIFIED ACCORDING TO NUMBER OF YEARS OF SERVICE

Consumption Kwhr	Number of Years of Service																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Over 15	Not Given	Total
0- 99	4	2	1	1		1				2	4	1	3	1		1		10
100- 199	21	19	13	25	3	2	1			2	4	1	3	1		6		91
200- 299	8	24	30	75	5	7	4	1	1	2	3	1	2	1		10	2	176
300- 399	1	11	20	20	3	1		1	2	1	5	2	5			2		81
400- 499	1	1	6	11	6	1	5	2		3	2	1	1	1	1	21		65
500- 599	1	3	6	6	5	4		1		2	2		2	4	2	8		47
600- 699	1	1	4	4	3	2	2	2	2	1	1	2	1	1		6		36
700- 799		4	5	7	2	2		1	1		1	2	1		1	7		34
800- 899	1	1	4	3	4	3			3	1		2	1	3	1	9		36
900- 999	1		4	7	3	2	1	2	1	1		3	1		2	7	1	36
1000-1099	1	2	3	4	4	2			1	1			3		2	3	1	37
1100-1199		1	6	3	2	2	1			1	1		2	1	1	5	1	33
1200-1299		2	7	2		3				1					3	4		22
1300-1399	1	3	1	3	1	1		2					2	2	1	4		19
1400-1499		1				1	1				2		1			3	1	10
1500-1599		2	5	2	1	1									2	3		16
1600-1699	1	1	2	2	1	3												8
1700-1799			2		2			1			1	1				1		8
1800-1899		1	1	2		5							1		1	1		12
1900-1999			1	2	2	1					1				1	4		12
2000 and over	4	17	21	16	10	13	2	7	3	0	5	2	3	3	2	33		101
	36	94	149	201	57	57	17	20	14	23	28	24	34	19	27	174	6	982
Medians (kwhr)	248	326	548	299	849	1199	419	999	832	899	524	949	1016	866	1399	992		

TABLE 14—FREQUENCY DISTRIBUTION OF AVERAGE RATES PER KWHR CHARGED BY ALL UTILITIES FOR FARM SERVICE, CLASSIFIED ACCORDING TO NUMBER OF YEARS OF SERVICE

Average Rate per Kwhr	Number of Years of Service																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Over 15	Not Given	Total
0c- 99c	1	3	.	1	1	1	.	2	1	2	2	2	.	1	1	13	..	31
1 - 1 99	3	9	5	9	3	16	1	3	1	4	1	7	3	1	5	23		97
2 2 99	4	5	15	6	7	6	3	4	5	4	4	3	4	5	1	27		107
3 - 3 99	4	10	16	20	9	16	3	4	1	5	5	7	2	5	7	34	1	157
4 - 4 99	1	6	13	14	4	5		2					4		6	21	1	66
5 5 99	1	4	17	12	7	6	1	1	2		6	3	2	2	3	20	2	86
6 - 6 99	1	3	7	9	12		2		2	3	1	2	2	1	1	11	.	57
7 7 99	6	5	13	32	7	1	2	1	1	1	4		1	3	4	17		98
8 - 8 99	2	5	10	32	2	1	4	1	1	2	2		1	1		3	.	67
9 - 9 99	1	7	4	12	3				.	1	1		.	1	1	4	.	34
10 -11 99	5	9	15	19	1	3	1	1	.		1	.	3	.	.	4		62
12 -13 99	2	18	22	22	2							1	2				1	66
14 15 99	4	3	9	13	.	.	.		.	.	1		1	1	.	1	1	35
16 -19 99	1	6	3	1	.	.	.	..	.	.	.	.	2	..		1	.	14
20 and over		1																1
	36	94	149	201	57	57	17	20	14	25	28	24	24	19	27	174	6	992
Medians	7.57c	8.39c	7 14c	7 98c	5.69c	3.24c	6.49c	3 12c	5.49c	3 12c	5.41c	3.06c	4.37c	5.99c	4.32c	3.56c		

TABLE 15—NUMBER AND SIZE OF ELECTRIC MOTORS USED ON FARMS

	Utility				
	Man. Power Comm.	Winnipeg Elec. Co.	Winnipeg Hydro	Other Utilities	All Utilities
No. of farms	560	488	89	21	1,109
No. of farms reporting motors	169	171	57	6	403
No. of motors reported	248	243	83	14	588
Size in horsepower					
Under 1	171	129	32	11	343
Over 1, under 2	37	54	23	2	116
Over 2, under 3	13	24	12	1	50
Over 3, under 4	9	21	7		37
Over 4, under 5					
Over 5, under 6	12	4	4		20
Over 6, under 7					
Over 7, under 8			3		3
8 and over	5	6	1		12
Not given	1	5	1		7
					588

TABLE 16—NUMBER OF MOTORS ON FARMS CLASSIFIED ACCORDING TO USE

	Utility				
Use	Man. Power Comm.	Winnipeg Elec. Co.	Winnipeg Hydro	Other Utilities	All Utilities
Pumping	114	122	45	2	283
Grinding	7	54	18	1	80
Shop tools	25	14	1	3	43
Cleaning grain	25	9	2		36
Crushing grain	14	5	3		22
Elevating grain	10	3		1	14
Sawing	3	9	1		13
Refrigeration		13	5		18
Fanning	12	2			14
General utility	12	4	4		20
Air compression			2	1	3
Oil pumping	1				1
Laundry	6				6
Wood-working		2			2
Miscellaneous	12	6	1		19
Not given	7		1	0	14
	248	245	83	14	588

TABLE 17—NUMBER AND PERCENTAGE OF FARMS REPORTING VARIOUS ELECTRICAL APPLIANCES

Appliance	Farms Reporting (100%=1,106)	
	No.	Per Cent
Iron	990	89.5
Radio	956	89.2
Washer	823	74.9
Toaster	577	52.2
Hot plate	340	30.7
Refrigerator	251	22.7
Vacuum cleaner	209	18.8
Range	184	16.6
Clock	155	14.0
Fan	120	10.8
Water system	117	10.6
Water heater	108	9.8
Cream separator	93	8.4
Milking machine	89	8.0
Heating pad	80	7.8
Sewing machine	77	7.0
Air heater	49	4.4
Waffle iron	46	4.2
Brooder	45	4.1
Rangette	45	4.1
Churn	38	3.4
Percolator	31	2.8
Bottle washer	28	2.5
Mixer	27	2.4
Incubator	25	2.3
Milk cooler	21	1.9
Ironer	17	1.5
Clipper	15	1.4
Honey extractor	13	1.2
Rectifier	12	1.1
Car heater	7	.6
Fireplace	6	.5
Soil heater	2	.2

TABLE 18—PERCENTAGE OF FARMS POSSESSING SELECTED ELECTRICAL APPLIANCES, FARMS CLASSIFIED ACCORDING TO NUMBER OF YEARS OF SERVICE

No. of Years of Service	No. of Farms	Percentage of Farms Possessing						
		Iron	Radio	Washer	Toaster	Hot Plate	Refrigerator	Range
1 or less	156	84%	75%	54%	30%	20%	12%	6%
2	95	96	86	74	38	27	19	15
3	149	85	81	82	54	38	21	9
4	203	93	97	82	50	38	14	8
5	57	89	95	75	56	42	35	18
6	57	91	89	74	61	40	32	25
7	17	82	76	65	59	35	12	12
8	19	89	100	68	68	21	42	26
9	15	93	80	67	67	13	13	20
10	25	100	96	72	60	12	32	40
11	28	86	93	75	54	21	18	18
12	24	88	100	79	71	29	29	37
13	34	91	100	74	85	44	41	29
14	19	84	95	84	53	32	16	21
15	26	100	100	100	85	50	65	31
Over 15	177	99	93	77	58	37	27	28

TABLE 19A—NET REVENUE OF THE MANITOBA POWER COMMISSION FROM FARMS CONNECTED TO LINES DURING 1937-1941

Net Revenue	Number of Years of Service				
	1	2	3	4	5
$ 0-$ 9 99	4			1	
10- 19 99	10	10	8	30	
20- 29 99	5	15	18	47	2
30- 39 99	2	14	26	18	2
40- 49 99	0	7	9	9	4
50- 59 99	1	5	23	27	6
60- 69 99	1	2	10	8	4
70- 79 99		1	1	3	2
80- 99 99			1	2	3
100- 119 99	1		4		1
120- 139 99			1		
140- 159 99			2		
160- 179 99			1	1	
180- 199 99				1	
200 and over			2		
	24	54	116	162	27
Medians	$18 49	$31 77	$47 21	$26 69*	$56 66

*In 1938 a substantial number of river-lot farms were connected, these are low energy users.

TABLE 19B—CONSUMPTION BY FARMS CONNECTED TO MANITOBA POWER COMMISSION DURING 1937-41

Consumption	No. of Years of Service				
	1	2	3	4	5
0- 99 kwhr	3		1	1	
100- 199	11	17	10	24	1
200- 299	5	16	29	70	1
300- 399	1	6	13	15	
400- 499			4	8	3
500- 599		3	3	4	2
600- 699			3	2	
700- 799		4	5	5	
800- 899	1	0	4	2	2
900- 999			3	6	3
1,000-1,099		1	3	3	3
1,100-1,199		1	4	3	1
1,200-1,299		1	7	2	
1,300-1,399	1	0	1	3	1
1,400-1,499		1			
1,500-1,599		1	3	2	1
1,600-1,699	1		1	1	
1,700-1,799			1		2
1,800-1,899			1	2	
1,900-1,999			1	1	2
2,000 and over	1	1	14	8	5
	24	54	116	162	27
Medians (kwhr)	165	202	549	280	1,066

TABLE 19C—AVERAGE RATES PER KWHR FOR FARMS CONNECTED TO LINES OF THE MANITOBA POWER COMMISSION DURING 1937-41

Average Rate per Kwhr	Number of Years of Service				
	1	2	3	4	5
0c- 99c					
1 - 1 99					
2 - 2 99	3		10	8	3
3 - 3 99	2	3	12	11	5
4 - 4 99		4	12	14	3
5 - 5 99		1	13	9	6
6 - 6 99	1	1	4	7	4
7 - 7 99	3	4	9	27	1
8 - 8 99	2	4	5	30	2
9 - 9 99	1	4	3	9	1
10 -11 99	3	3	14	18	1
12 -13 99	2	13	22	22	1
14 -15 99	4	7	9	11	
16 -19 99	1	5	3	1	
20 and over		1			
	24	54	116	102	27
Medians	10 09c	9 37c	7 82c	8 27c	5 49c

TABLE 20—BASIS OF SERVICE ON FARMS BY TRANSFORMER OR OTHER MEANS; SIZE OF TRANSFORMER

Service	Man. Power Comm	Winnipeg Elec Co.	Winnipeg Hydro	Other Utilities	All Utilities	Per Cent
Separate transformer	268	68	34	14	380	34
No separate transformer	287	370	55	7	719	65
Information not given	4	5			9	
	560	438	89	21	1,108	
Size of transformer						
1 K.V.A.		1	1		2	
1½	15				15	
2	1	2			3	
3	57	12	2	9	80	21
4		2			2	
5	180	31	13	1	225	59
7½	8	2	5		15	
10	3	5	5		13	
15		2	1	1	4	
25		1			1	
Not Given	5	5	7	3	30	
	269	63	34	14	380	
	Basis of Service Where No Separate Transformer Was Reported					
By connection to:						
Town or Village Distribution	75	104	24	5	208	41
Rural secondary line	207	362	31	2	402	56
Not stated	5	14			19	
	287	370	55	7	719	

TABLE 21—FARMS CLASSIFIED ACCORDING TO WHETHER RESIDENCE ONLY OR RESIDENCE AND OUTBUILDINGS ARE WIRED

Building Wired	Man Power Comm.	Winnipeg Elec. Co.	Winnipeg Hydro	Other Utilities	All Utilities	Per Cent
Residence only	182	107	3	2	294	27
Residence and outbuildings	306	316	31	18	791	70
Not given	13	15	5	1	34	3
	501	458	39	21	1,109	100

CHAPTER X

REDUCING THE COST OF POWER LINES AND APPLIANCES

If a comprehensive farm electrification programme is to be entirely successful as a postwar employment programme, the ultimate cost of material and supplies, apparatus, and appliances must be substantially reduced below the prewar figures. This chapter will analyze this problem and describe in some detail the activities of the R.E.A. in the United States in effecting economies and securing a high saturation of farmers along the line and of appliances upon the farm. The Commission is of the view that the techniques successfully evolved by the R.E.A. bear careful study by Canadian manufacturers, contractors, and all those concerned with a postwar farm electrification programme.

The Cost of Appliances and Electricity Consumption

A generation ago Samuel P. Steinmetz of the General Electric Corporation stated that electricity is high in price because the usage is low, and the usage is low because the price is high. A solution to this dilemma came with the reduction in the price of electrical service. In the United States rates have declined gradually for many years, particularly since the 1930's with the growth of the Tennessee Valley Authority, the R.E.A., and a number of other public projects. In Winnipeg reductions in rates were made in 1912. The lower rates stimulated consumption to the extent where the citizens of Winnipeg, with an average annual domestic consumption of 5,000 kwhrs. became perhaps the heaviest consumers of electricity in the world.

There are, however, limits upon the extent to which reduced rates can be used as a means of increasing consumption. Throughout most of Manitoba the costs of generating and transmitting electrical energy are already so low as almost to remove the possibility of lower rates as a result of lower costs of generation in the near future. It is a recognized fact in the field of electrical utilities that in such a situation any further expansion in the utilization of electric power must come from a reduction in the price of electrical apparatus and appliances. In fact, once the energy run-off rate reaches one or two cents, almost the only factor limiting utilization is the cost of the appliances themselves, the cost of the energy is no longer a factor.[1] This may be the problem which the citizens of Manitoba will face in the postwar period.

An examination of existing prices convinces this Commission that to a major extent the feasibility of developing an expanded programme of farm electrification will depend on the degree to which reductions can be obtained

[1]House heating is an exception. "Run-off rate" refers to price charged for the final block of energy per month.

in the prices of electrical appliances and apparatus used in the extension of farm service. This view is strengthened by a comparison of prices in Canada with those prevailing in the United States. On the other hand, it may be suggested that a programme of widespread rural electrification in itself, by increasing the demand for electrical equipment, may act as the impetus essential to reduced prices of appliances and line equipment.

Meters which meet the standards set up by the Bureau of Standards of the United States Government and the National Electrical Code are available to farmers in the United States at a price of about $8 to $9, the meter which conforms to minimum Canadian standards costs the farmer approximately $12 to $15, or 66% higher than the American price.[2] For very light farm service, the United States farmer is able to secure a transformer for about $21, the standard 1½ K.V.A. transformer sells for approximately $39 and the 3 K.V.A. unit for close to $48 in the United States.[3] In Canada equipment for similar purposes costs $71 for the 1½ and $101 for the 3 K.V.A. units. A small ¼ horsepower motor, used for water pumping, milking, and running the washing machine, sells for approximately $8 to $10 in the United States. A motor of the same size, manufactured and sold in Canada by the subsidiary of the American firm producing the same motor in the United States, sells for $15 to $18 in Canada.

The following comparative prices were secured from a company manufacturing in both countries:

Appliance	Price in Canada Prewar	Price in United States Prewar
Refrigerator, 6 cu. ft.	$295 00	$159 00
Refrigerator, 4 cu. ft.	199 00	120 00
Special coffee maker	11 50	7 95
Waffle iron	8 75	6 95
Coffee maker	8 75	6 95
Percolator	6 95	5 95
Turnover toaster	4.40	3 95
Sandwich grill	9 50	8.95
Waffle grids for grill	3 50	2 50
Special iron	7 95	6 95
Iron	2 95	2 95

[2]This differential is due in part to the fact that Canadian standards require a somewhat more expensive meter. Some engineers believe that these standards are too rigid and that they could be revised without adverse consequences.

[3]The typical farm in the United States requires a 1½ K.V.A. transformer.

The articles are identical in quality, differences being superficial. In small items and for which a substantial market exists the disadvantage in Canada is slight, but in the case of larger units, such as refrigerators or transformers, the difference is large.

Similar comparisons could be made for other units and appliances which are important in a farm electrification programme. Almost every item, whether it is wire, hardware, transformer, meter, insulator, lightning arrester, or energy-using appliance, is higher in price in Canada than in the United States. It is unnecessary to emphasize the degree to which high prices for appliances and other equipment may constitute a barrier to an effective programme of farm electrification. The nature and causes of this bottleneck deserve some consideration.

It seems reasonable to assume that the high prices of electrical appliances in Canada are not due to the relative incompetence of the country's industrial leaders. The major manufacturing firms are under the management of aggressive businessmen and make use of well trained, competent engineers and other personnel. The explanation of the high cost of appliances and equipment is rather to be found in the market conditions under which Canadian manufacturers operate. The fact remains, however, that from the point of view of the consumer, the results obtained are not entirely satisfactory, nor is it to be expected that consumers will accept these results in the future.

Canada, with a population of 11 millions and artificial tariff barriers, does not provide a market large enough for the most successful adaptation of mass production techniques. The United States suffers less from its high tariff than do most countries because the internal market is large enough to make mass production methods possible in nearly all industries. Canada, on the other hand, pays an enormous price for its attempt to become more self-sufficient in manufactured products.

Not only does the limited market impede modern technology and production methods, but it facilitates undesirable restrictions on competition among manufacturers.[4] In this element of monopoly may be found another explanation for the high prices of electrical appliances and equipment. Until these monopolies are broken, or the business leaders realize that their very survival depends upon a more progressive price and production policy, a farm electrification programme must operate under a severe handicap.

For Canadian manufacturers to enter on a courageous and enlightened price policy does not necessarily mean accepting a lower total profit on operations. In view of the increased demand that would accompany widespread rural electrification, a larger turnover, even at considerably reduced unit prices, may conceivably result in greater total profits. The reason for this is that with expanded volume of production unit costs would be reduced.

[4]For evidence see Lloyd G. Reynolds, *The Levelization of Competition in Canada*, Harvard University Press, 1940, and Report and Minutes of Royal Commission on Price Spreads, 1935, Ottawa.

The chief obstacle to lower prices in the past has been the high cost of doing a small volume of business and the monopolistic practices which led manufacturers to accept low volume complacently

The situation in which the manufacturer and consumer find themselves can be clarified by a study of the following tabulation

Unit Selling Price	*Unit Cost*	*No. Sold*	*Total Profit*
$10 00	$5 00	100	$ 500
9 50	4 90	125	575
9 00	4 60	160	704
8 00	4 20	220	836
7 00	4 00	300	900
6 00	3 80	450	990
5 00	3 50	700	1,075

Suppose the manufacturer is producing for a limited market in which large volume has never been attained. He complacently and unimaginatively sets his sights low and fixes a price of $10 per unit. Each unit costs him $5 to produce and he is able to sell only 100 units in a year, leaving him a profit of $500 on the item. If, however, he recognizes that there is an enormous potential untapped demand, from the beginning fixes the price at $5, and secures sufficient volume to sell 700 units instead of 100, then his unit cost is $3.50 and his total profit is $1,075 instead of only $500.

Shortly after the creation of the Ford Motor Company, Henry Ford engaged in a terrific struggle with his fellow directors over precisely this type of problem—the price of the motor car Mr Ford wanted to make a drastic cut in the price, sell an enormously increased number of units, make a small profit on each but a larger aggregate profit through the larger turnover. Mr Ford's fellow directors refused, he decided to resign from the company and start a new enterprise in which he could put to the test the courage and vision that was in him. Before he resigned, his associates finally reconsidered the matter and reluctantly agreed to let him try his "wild scheme." The entire world knows the results. The company paid a dividend of 5% *per month* for years and in addition ploughed back into the business hundreds of millions of dollars in additional profits. Said Ford "My policy is to reduce the price, extend the operations, and improve the article You will notice that the reduction of price comes first. I have never considered any costs as fixed. Therefore I first reduce the price to a point where I believe more sales will result . . . The new price forces the costs down." More important, however, this decision made it possible for nearly everyone, including wage workers, to enjoy the benefits of mass transportation.

The advantages and uses of electricity on the farm are so enormous and diverse that this Commission believes the Canadian farmer will respond most enthusiastically in the postwar period to a low price policy on the part of electric apparatus manufacturers. As seen above, such a policy need not impair the profits of the manufacturer, indeed, his profits may actually be larger under such an imaginative and dynamic price policy.

The large Canadian electric manufacturing companies are affiliated directly with similar companies in the United States. They have substantially the same quality of management. Yet we find this enormous disparity in prices. This can be explained in either of two ways: (1) Canadian producers are so few in number that effective competition does not exist, or (2) the Canadian market is too small to allow the consumer to get the benefits of mass production. Regardless of the cause of high prices in Canada the people of Canada do not need to accept this condition complacently because there is an easy solution which would in no way reduce employment or profits in either country. Indeed, by opening up new markets, which are now closed to the manufacturer because of the high prices, the following proposal should increase employment and profits.

The proposal. Instead of Canada trying to be self-sufficient in nearly every item of electrical supply, arrangements should be made whereby some complete items or those parts of a transformer, a meter, a refrigerator or any other item in the production of which Canadian manufacturers could obtain low costs by mass production methods should be concentrated upon in Canada to supply the Canadian market and to supply a part of the United States market. Likewise United States manufacturers would not necessarily endeavour to produce a completed product in every instance but would obtain parts of many products in Canada, and in return many of the parts on which United States producers concentrate in excess of United States requirements would flow into Canada to be assembled into the finished product. Such items or parts would move over the international boundary duty free and give the consumers in both countries the benefit of low costs without interfering with employment or profits in either country.

Article 7 of the Lease-Lend Agreement signed on February 23, 1942, and Article 4 of the Atlantic Charter declares that one of the peace objectives shall be the free flow of international trade. In December, 1942, Canada and the United States announced an exchange of notes agreeing to a postwar policy of tariff adjustment. A better world in terms of greater regional equality and more equal access to goods, is among the announced objectives for which World War II is being fought. Manitoba citizens are in this fight.

The Manitoba consumer has a right to expect substantial tariff readjustment after the war. Canada cannot afford to handicap its farmers by a

failure to make available to them the necessary tools of production at prices reasonably comparable to those prevailing in the United States.[4]

R.E.A. Reduces Costs

To a substantial degree the R.E.A. is responsible for inducing United States manufacturers to understand the character of the farm demand for electrical apparatus. Quoted or list prices were not the prices from which the R.E.A. began its discussion and investigation. Rather the R.E.A. began its activities in precisely the way in which the low price policy for energy was inaugurated in Winnipeg in 1912. That is, the R.E.A. made a study of the price at which farm power lines and apparatus must be available if farm electrification was to become a going concern. Then it went to the manufacturers and informed them of the maximum price at which a large volume could be absorbed. Hundreds of the manufacturers were horrified at such a price-making procedure; many refused to co-operate. However, in every case, somewhere at sometime, some manufacturer was found who would do the job at the price suggested. Sometimes this manufacturer was a producer of one of the established lines of appliances; frequently the producer who got the order had never before manufactured a commodity of this type. The R.E.A., however, was taking few or no risks because every item had to be made according to rigid specifications and to stand up under usage.

Furthermore, distribution in many cases was not through ordinary retail channels. Rather the R.E.A. made the agreements in behalf of numerous co-operatives. Thus the normal selling, soliciting, and advertising costs and the costs of distribution in small driblets were either entirely eliminated or greatly reduced. The Manitoba Power Commission has experimented with somewhat similar procedure in several instances. For the postwar period such a procedure should become standard practice.

Similarly in regard to construction procedure, the R.E.A. has removed the existing bottlenecks. A procedure has been set up in which the various items that go to make up a tap pole assembly, for example, are grouped into one unit, the contractors are asked to bid on these units, including the cost of installation. The R.E.A. is in a position, by the time the bids are called, to state that the successful bidder will have 100, or 500, or 1,000 units to install. The contractor is relieved of the costs of soliciting business, if he is the lowest responsible bidder he gets the job. If the job is too large for the successful bidder to accomplish in the required time, the other bidders are offered sections of the job at the price bid by the lowest bidder. Thus another bottleneck is broken. No attempt is made to induce the contractor to work for nothing, the purpose of this method is merely to remove the wastes in the traditional procedure and to secure the benefits of mass construction for the farmers.

[4] By this recommendation the reader should not conclude that this Commission favors postwar reconstruction restricted to a bilateral basis.

In other cases bids may be called for the construction of the entire line by a single contractor, instead of breaking up the job into numerous constituents such as pole installation, wire assembly work, tap pole work, etc. Under this procedure the R.E.A. has reduced the cost of single-phase line construction to an average of $628, including the entire line, strung to the farmer's yard pole, service drop, and consumer's transformer and meter. To the above figure must be added approximately 15 to 20% for engineering, supervision, administration, and other related costs, bringing the total to some $750 per mile of single-phase line. In many instances this figure has been reduced by as much as $150. The national average is $750.

Building Wiring

The R.E.A. has made a similar attack upon the high cost of wiring farm buildings. Leaving some buildings unwired or providing insufficient outlets because of high costs per outlet does not constitute "total farm electrification."

It was found possible to obtain very low wiring prices as a result of group meetings between the superintendent and officials of the co-operative and the house-wiring contractors. At these meetings the superintendent informed the contractors of the number of farmsteads to be wired, together with their individual requirements. Emphasis was placed on the fact that all work would have to be done in accordance with the specifications of the National Electrical Code. It was also emphasized that there would be no need for the contractors to solicit the members, since they had already expressed themselves as to the amount of house wiring needed. In most cases these meetings resulted in very reasonable prices and satisfactory agreements between contractors as to the amount of work each would perform. Typical bid prices for unit installations are listed below:

Light outlets*	$1 05
Single-pole switch outlets	1 95
Convenience receptacles	1 95
3-way switch outlet	3 45
Range receptacle (including 20 feet of cable)	8 50
Yard light	3 65
Complete 3-wire service entrance	8.50
Magnetic breaker	5 95

*This consists of complete unit of ceiling lampholder or pendant.

R.E.A. Self-Help Projects

Farm electrification in the United States under the R.E.A. closely follows a pattern which was developed in some of the European countries and in the United States prior to the activities of the R.E.A. Under this system local groups of farmers in several townships, in a county, or several counties combine to form an electric co-operative under the state co-operative laws.

In some of the states where farms are large, or incomes are substantially below the average, a special system of "self-help" has been developed. Under this system a large part of the responsibility and work of initiating and promoting the project and of constructing the lines is carried out by the farmers themselves.

The self-help plan has two main objectives, each objective being achieved in several ways. The first aim is to put the co-operative on a self-sustaining basis from the beginning, which will help insure the security, and facilitate the amortization, of the loan made by the national government. This is done by enabling the members to take an active part in the formation of the co-operative and the construction of the distribution system. The members obtain work in the construction of the line, in return for which they receive possibly 25% in cash and 75% in credits to be applied on their building wiring and appliance purchases. Furthermore, they pool their purchasing power, thereby bringing the cost of appliances and house wiring more nearly within the reach of their pocketbooks.

The second objective of the self-help project is to reduce to a minimum the cost of the construction of the system and the overhead. This is done by the use of native timber for poles and cross arms, if necessary, the butt of the pole being suitably treated. The system of lines is constructed by the force-account method, using member labour to the fullest extent possible.

Early in the organizational procedure a special self-help committee is appointed to select the personnel of the various working committees and to take care of other related detail. This main committee usually includes members of the board of directors of the local co-operative, government agricultural agents who have been active in the development of the project, and others whose knowledge and advice are considered to be valuable.

Generally five working committees are set up to assemble and distribute, through the aid of fellow members, the information required to carry forward the programme to complete member participation. The various committees and their duties are substantially as follows:

1. *Group purchase committee* — In collaboration with the co-operative adviser and co-ordinator, this committee is responsible for all wiring and for the group purchase programme.

2. *Labour committee* — This committee is responsible for selecting members for work in each section of the system, using the membership participation agreement which the members have signed as a guide for the selection of workmen.

3. *Office committee* — This committee is responsible for selecting a suitably located office and providing for the necessary facilities.

4. *Credit Committee* —This committee reviews all applications of members for building wiring, plumbing, and appliance lines, with a view to deciding whether or not a member is deserving of credit. If a member is of

good standing in the community and is an aggressive, hard working individual who makes an honest effort to pay his bills, he is given every consideration in determining his desirability as a credit risk.

5 *Co-operative education committee* This committee acquaints itself thoroughly with co-operative practices and the history and progress of the R.E.A. programme, and acts as a clearing house for questions about the co-operative. A thoroughly planned programme of publicity and public relations is conducted. The committee generally contributes a weekly article to the local newspapers in the project area, reporting programme progress and stressing the advantages gained through full and complete membership co-operation.

All committees are responsible to the board of directors for the plans and progress of their work, and the final decision on any question of policy rests with this board [8]

R E A officials at headquarters are firm in their conviction that the high saturation of customer density and the almost 100% of co-operative solvency could not have been achieved without the aid of this self-help programme in the thinner territories. In Minnesota, for example, approximately 20% of the local co-operatives are of the self-help variety It is significant to notice, however, that all the self-help projects are in the northern half of the state, where the soil is light and the incomes are substantially below the average. As the following tabulation indicates, the average income in 1939 per acre of farm land in Minnesota was $10 55, whereas in most of the self-help communities it was only about half this figure.

Area	*Income per Acre*	*Income per Farm*
Minnesota	$10 55	$1,779*
Roseau County	5 56	1,351
Lake of the Woods County	5 03	787
Koochiching County	4 90	562
Itasca County	5 77	591
Beltrami County	5 27	658
Cass County	4 72	653
Wadena County	5 74	912
Hubbard County	4 50	658
Pine County	7 35	844

*Average Manitoba farm incomes are about two-thirds to three-quarters of this figure.

In the interests of accuracy, it should be stated that the above figures refer to the average income per acre of farm land in the county in which the headquarters of the co-operative is located, whereas the co-operative itself may have its lines running into one or more neighbouring counties in which the income may be somewhat higher or lower than the figures stated in the tabulation. Nevertheless, the situation is as stated By following the self-help policy, under which the farmers dig the holes, get the poles out of the woods, and in some instances do some of the overhead and other construction work,

[8] For a full and complete account of the self-help procedure, see the pamphlet entitled *Self-Help*, prepared by the R.E.A., St. Louis, Missouri.

and in all cases assume the major responsibility of promoting interest and saturation, the farmers have made possible an electrification programme in thin areas. In April, 1940, 6.6% of the farms in the counties listed above were electrified. The Commission has reason to believe that since that date the number of electrified farms has doubled.

For the most part these self-help activities have not reduced the cost of constructing the lines materially below the figure that the R.E.A. has achieved in the non-self-help projects. This is true for two reasons. In the first place, even the ordinary co-operative projects rely very heavily upon member interest in promoting saturation and educational work. In the second place, in most instances where self-help is relied upon, the workmen who are members of the co-operative are paid at local rates for whatever work they do. Thus the actual dollar saving is not substantial in most instances. Nevertheless, the self-help project has the great advantage of helping farmers earn money or credits in their spare time which will help to defray the cost of wiring their buildings and purchasing their initial appliances. This has the further advantage of achieving a somewhat higher saturation of members along the line and of getting a higher saturation of appliances in use from the beginning.

To what extent these self-help activities found useful in the United States may be adaptable to a Manitoba farm electrification programme in the postwar period this Commission is unable to determine. However, the Commission is of the view that the Manitoba Power Commission should explore the possibility of adapting this technique to a Manitoba farm electrification programme, and since this programme has been found of substantial benefit in the United States, it is quite probable that at least in some thin Manitoba areas it may help to bring power where it would otherwise be unobtainable.

Self-Meter-Reading, Self-Billing, Patrol Activities

Self-help activities in the United States do not stop when the line is constructed but are extended to operations as well. Early in the R.E.A. programme officials came to the conclusion that typical methods followed by public utilities were not adaptable to farm electrification. From the start a few of the co-operatives began to experiment with a system under which the farmers read their own meters, and later on a number of the co-operatives induced the farmers to calculate their own bills and accompany their report on the meter-reading and billing with a cheque mailed to headquarters.

Because of great distances between farms and poor roads during winter and wet weather, meter-reading was very costly when done in the traditional fashion. The expense varied from $1 or $2 up to $3 or $4 per customer per year, an undue drain on annual revenues.

At the present time over 80% of the 900 co-operatives use the system of self-meter-reading. This Commission has made a careful investigation of the difficulties that might be encountered in this connection. Among the first discoveries of the R.E.A. co-operatives was that the ordinary clock dial meter is not adapted to self-reading. As a result an automotive appliance maker was induced to manufacture what is known as the "cyclometer." These meters are available at about $8 each in quantity lots and are read exactly the same as an automobile speedometer, so that errors are almost completely eliminated.

The Commission asked the Minnesota and North Dakota co-operatives to estimate the monthly savings achieved through self-meter-reading. The results obtained are indicated in the following tabulation:

Savings per Farm cts	*No. of Co-operatives Reporting*
1– 5	4
6–10	12
11–15	4
16–25	2
26–35	1
36–50	2
	25

Obviously it was difficult to estimate accurately the savings through the elimination of this one operation. It will be noted that 5 of the 25 co-operatives estimated their savings as in excess of 15c per month, or $1.80 per year per member. In several instances the estimated savings were twice this figure; in other cases, the estimated savings were lower.

Somewhat over 5% of the co-operatives in the United States have gone one step further and now require their customers to calculate their own monthly bills, and thus effect some additional savings. In Minnesota and North Dakota, out of 33 co-operatives for which data were received, one-third are now engaged in self-billing as well as self-meter-reading. Five of these report additional savings of up to 5c per member per month, four estimate their savings as between 6c and 10c per member per month, and in one case the estimate is 25c per member per month, or $3 per year. While these savings may appear trivial, it must always be remembered that the costs of running an enterprise are composed of scores and perhaps hundreds of transactions. Small, seemingly inconsequential savings in connection with this or that operation, when accumulated and calculated in the aggregate, may mean the difference between solvency and insolvency.

Under the systems now in operation among the co-operatives engaging in these cost-reducing devices, many varieties of postcards are in use. Each month a few days before the meter-reading date, a self-addressed and stamped postcard is mailed to each member. This card states the meter-reading date and has a diagram on which the current reading of the meter is to be recorded.

In the case of self-billing the customer is provided with a large card showing the total cost of varying quantities of energy so that he needs to make no calculations. The meter-reading date is clearly indicated in red letters. A dozen self-addressed envelopes are provided for mailing the meter-reading stub and for the enclosure of a cheque covering the amount due for the month. On the stub is a special blank to show any amounts due on appliances or other purchases. In some cases, as a further reminder of the meter-reading date, the co-operative makes it a matter of policy to insert a meter card in the monthly bulletin so that it will arrive one or two days before the reading date and draws this date to the attention of the subscribers. Thus the responsibility is put on the customer and the meter-reading and billing costs are reduced to a minimum. In such cases, however, the co-operative checks the meters and the accuracy of the readings several times a year.

In a few instances, in order to remind the customer of the approach of the meter-reading date, the lights are blinked three times three days before the meter is to be read, a day later the lights are blinked twice, and on the third day, when the meter should be read, they are blinked once, the blinking occurring shortly after dusk, thus reminding the farmer of his responsibility.

In order to reduce further the operating costs, substantial patrol responsibilities are placed upon the members, and more especially upon the directors of the local co-operative. The local directors, usually nine in number, are selected so there will be one in each part of the territory. When trouble occurs, such as power failure, broken poles, or other difficulties, the member is required to communicate with the nearest director. With the passage of time the director becomes something of an amateur expert in diagnosing the difficulty. In some instances he may even take a hand in correcting the defect if the trouble is within easy reach. Thus, instead of the local headquarters being deluged with an excessive number of service calls, part of the servicing is done by the directors themselves. Of course, every member is made to realise that the handling of service calls can make or break a project.

As an aid to facilitating this part of the programme, the R.E.A. succeeded in inducing the manufacturer to equip the meter, without additional expense, with a small switch and light. Thus, when a member telephones the director that the power is off, the director asks the member to step over to his meter and press the switch. If the bulb in the meter lights up, the director knows that the power failure is due to some break in the circuit on the farm itself and not in the power line. Frequently, a short conversation with the member will help locate the trouble and thus make unnecessary the service call from headquarters.

In order to make these self-help operating activities effective, the farmers must be made to feel that this farm electrification programme is *their* programme. Substantial duties and responsibilities are placed upon them and

they must be made to shoulder these duties and responsibilities willingly. This Commission is of the opinion that for each local area in Manitoba a special advisory or consulting committee of farmers should be set up by the local communities themselves, with, however, the co-operation of the representatives of the Manitoba Power Commission. These local committees should assume major responsibility for the spreading of information and knowledge and should be engaged in a constant educational programme, especially during the winter months. Furthermore, these committees should be pressed into service wherever they can function effectively, both in connection with the initial organization of the farmers and the construction of the line and subsequently in the operation of the system.

Conclusions

The foregoing description of some of the achievements of the R.E.A. does not exhaust the list. Rather they are illustrative only. These achievements and the method of tackling problems constitute an outstanding example of enterprise and efficiency. Obstacles to rural electrification are viewed by R.E.A. officials as challenges and they simply refuse to accept any difficulty as impossible of solution. This problem-solving attitude is a point of view deeply instilled in the minds of every official in responsible position.[7] The results attained are the reward for this enterprising and pioneering spirit. Many of the things done by the R.E.A. have been done elsewhere,[8] though generally they have not become standard practice but have been done spasmodically or only under the greatest stringency. This is due, in part, to the fact that the R.E.A. is the first large organization, perhaps in the history of the world, to devote all of its energies exclusively to farm electrification. Furthermore, the many dire predictions of its ultimate failure no doubt helped to spur it on to success.

This Commission believes that the farmers of Manitoba should and can have the same benefits as those south of the boundary. Canadian manufacturers must co-operate in this endeavour through a progressive price policy. A fundamental re-orientation of tariffs, an announced war aim, is required if these benefits are to be realized.

[7]See, for example, an address by M. M. Samuels, R.E.A. News, October, 1942, p. 8.

[8]For example, the R.E.A. gives credit to the Ontario Hydro Electric Power Commission for many of its ideas and techniques.

CHAPTER XI

WATER POWER RESOURCES OF MANITOBA

Manitoba is particularly fortunate in having abundant water power resources, many of which lie within 100 miles of Winnipeg and the surrounding industrialized municipalities. For many years the developed water power sites on the Winnipeg River have supplied low cost power not only to the Winnipeg area but also to the network of transmission lines carrying power to

Winnipeg River in Flood

the western boundary of the province. This chapter, the material for which has been prepared by Mr. C. H. Attwood, Director of Water Powers for the Province of Manitoba, indicates the extent of these resources and the present state of their development and utilization. It also shows that the burden which extensive farm electrification would place on the water-power resources located nearest to the agricultural area of the province would be of relatively minor importance.

Manitoba Drainage System

There are three main river systems in Manitoba, the Nelson, the Churchill, and the Hayes. These rivers drain an area of approximately 800,000 square miles, or more than twice the total area of the province.

The Nelson River system, with a total area of some 450,000 square miles, includes the Saskatchewan River, which has its source in the Rocky Mountains, the Winnipeg River, with some 48,000 square miles of drainage area in Ontario and Minnesota and the Red River with its source some 200 miles south of the international boundary. These three main tributary streams flow into Lake Winnipeg, a body 9,500 square miles in area, from which the Nelson River flows to Hudson Bay. Draining into Lake Winnipeg are also the waters from Lake Winnipegosis, 2,000 square miles in area, and Lake Manitoba, 1,700 square miles in area. These lakes form excellent regulating basins and are an important factor in the future scheme of power development in Manitoba.

The Churchill River system, with a drainage area of 113,000 square miles, lying to the north of the Nelson River drainage, has its source in Alberta and flows easterly across north-central Saskatchewan and northern Manitoba, finally discharging into Hudson Bay at Fort Churchill.

The Hayes River system drains an area of some 32,000 square miles in northeastern Manitoba and discharges into Hudson Bay at York Factory.

The power resources of Manitoba lie chiefly within the Pre-Cambrian shield, that is, to the east and north of a line drawn from the Lake of the

Pointe du Bois Hydro Electric Development on the Winnipeg River

Woods on the eastern boundary, running northwesterly to the lower end of Lake Winnipeg, thence northerly along the lake to its northern extremity, and thence northwesterly to the western boundary of the province in the vicinity of Flin Flon. In this area there are thousands of rock-bound lakes which provide a natural regulation of the stream flow, and the rock formation at all rapids and falls provides good foundations for power or storage control structures.

To the west and south of the Pre-Cambrian shield is the agricultural portion of the province. In this area the stream gradients are gentle and the rivers have a wide variation of flow, due to the absence of regulating basins and to climatic conditions. Under these circumstances opportunities for power development are few unless combined with steam power plant installations.

Administration of Water Power

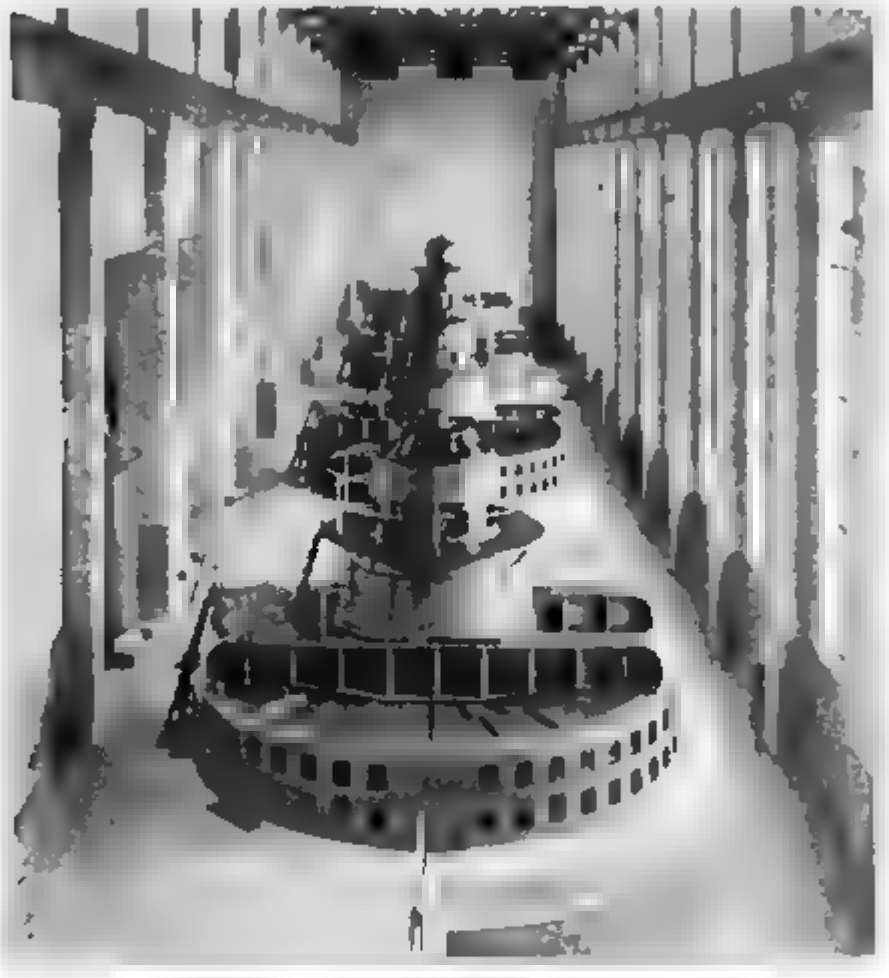
The water powers of Manitoba are administered by the Department of Mines and Natural Resources under the provisions of the Water Power Act. This act provides that the water powers are to remain vested in the Crown, no outright sale of them being permitted. Power sites may be leased to approved licensees for a definite term of years upon certain specified conditions. Provision is also made for exercising an effective measure of control over the plants, the auxiliary works necessary for storing and using the waters, and the transmission of power. The policy of the department is, briefly, to encourage desirable development of the water power resources, to ensure that each site developed shall utilize, or provide for the future utilization of, the maximum available power; to ensure adequate storage measures in the interests of all powers affected, and to promote in every way the fullest conservation of the power resources of the province.

Power Resources

Practically all electrical energy utilized in Manitoba is produced by hydro electric development. In addition to that which is produced in Manitoba, hydro electric power is imported from Saskatchewan to serve the mining industry at Flin Flon and Sherridon at the northwest boundary of the province. Power is also exported from Manitoba to the pulp and paper mills at Kenora, Ontario, and a small amount to the United States at Gretna.

During the calendar year 1941 the output of the hydro electric plants in Manitoba totalled 1,532,263,090 kwhr, or 252,056 horsepower years, and the peak demand for power totalled 395,000 horsepower. The power imported totalled 383,871,233 kwhr, or 58,750 horsepower years, and the power exported totalled 18,650 horsepower years. Of the total power sold, domestic and residential requirements used 19%, commercial 8%, and industrial 73%. Of the industrial load, the mining industry used 32.3%, the pulp and paper industry 28.5%, and other industries 39.2%.

The power developed in the province to date is almost entirely on the Winnipeg River



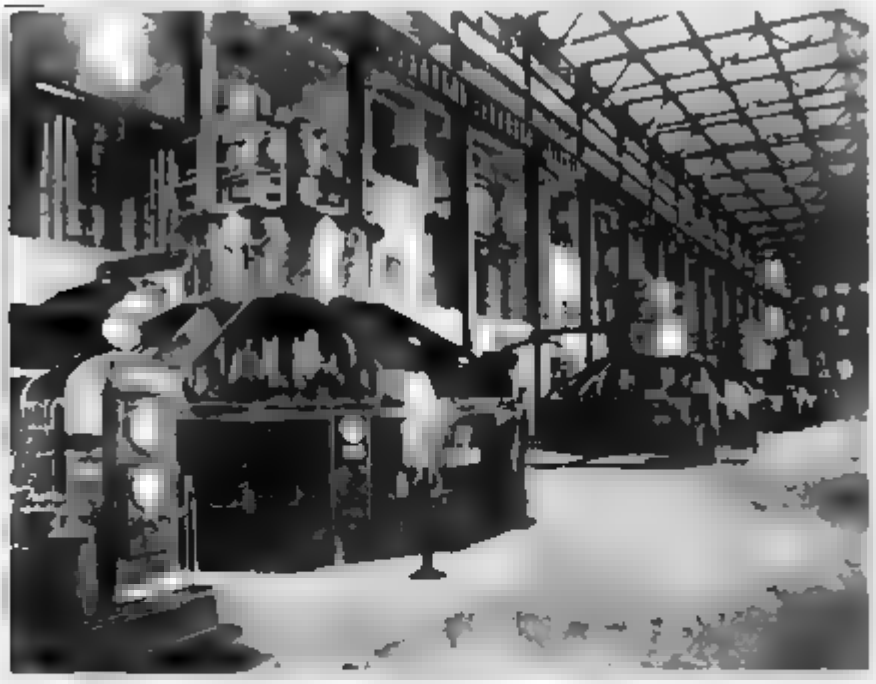
Interior of Seven Falls Power Station on the Winnipeg River

Table 3—Water Power Developments in Manitoba

Owner	River	Location of Plant	Head in Feet	Capacity in Horsepower	
				Present	Ultimate
City of Winnipeg	Winnipeg	Pointe du Bois	44	125,000	125,000
City of Winnipeg	Winnipeg	Slave Falls	30	40,000	80,000
Winnipeg Electric Co.	Winnipeg	Pinawa	44	57,000	To be abandoned
Winnipeg Electric Co.	Winnipeg	Seven Sisters	36	60,000	125,000
Winnipeg Electric Co.	Winnipeg	Great Falls	44	100,000	100,000
God's Lake Gold Mines	Island Lake	Kanuchuan	18	1,500	5,700
				423,500	505,700

The first development was the Winnipeg Electric Company's plant at Pinawa, completed in 1906. This was followed by the completion of the City of Winnipeg's plant at Pointe du Bois in 1911. These early developments were followed by the development at Great Falls in 1922 by the Manitoba Power Company,[1] the development of Seven Sisters in 1931 by the North Western Power Company[1] and the development at Slave Falls in 1931 by the City of Winnipeg. The only other hydro electric plant in Manitoba is that of the God's Lake Gold Mines Company at Knox Juan Rapids in the Island Lake River completed in 1933. These plants have at present an installed capacity of 420,700 horsepower and an ultimate capacity of 590,700 horsepower.

As previously stated, the most important power resources are situated within the Pre-Cambrian shield or in eastern and northern Manitoba. The one important exception to this is the possible diversion of the Saskatchewan River waters into Lakes Winnipegosis and Manitoba to utilize the storage capacity of these lakes and the development of power at the Dauphin River site. This proposed scheme of development provides for a greater measure of water conservation and the location of a large source of power closer to the centres of population in the agricultural area of the province.



Interior of Great Falls Development on the Winnipeg River

[1]Now merged with the Winnipeg Electric Company

The main power rivers are the Churchill, Nelson, and Winnipeg. On the Winnipeg River five sites have been developed, two by the City of Winnipeg and three by the Winnipeg Electric Company. There are still two undeveloped sites on this river capable of producing from 100,000 to 125,000 horsepower. When these are completed and the Seven Sisters and Slave Falls plants have been brought up to their ultimate capacity, the Manitoba sections of this river will be completely developed.

On the Nelson River the total drop from Lake Winnipeg to Hudson Bay is 712 feet. Depending upon the stream-flow regulations, the total estimated power available is from 2,235,000 to 3,652,000 horsepower. Present information indicates that this power can be obtained at several sites, each with capacities varying from 100,000 horsepower to 250,000 horsepower.

On the Churchill River at Island Falls, fifteen miles west of the Manitoba boundary, there is a hydro electric development of 100,000 horsepower, owned by the Churchill River Power Company. The power produced by this plant is transmitted to and used by the mines at Flin Flon and Sherridon and by those communities.

The estimated power available on the Churchill River in Manitoba at ordinary minimum flow is 1,500,000 horsepower. This power is available at a number of sites, some of which are at the outlets of large lakes in the river system, which fact would provide storage and pondage to give great flexibility in power production. From present information, these sites are capable of developing from 92,000 to 150,000 horsepower each.

On the Grass and Burntwood Rivers, lying between the Nelson and Churchill Rivers, there are a number of power sites capable of developing from 500 horsepower to 5,000 horsepower each. On the Island Lake River at Kanuchuan Rapids the hydro electric plant of God's Lake Gold Mines has a present installation of 1,000 horsepower and an ultimate capacity of 5,700 horsepower. Additional power sites on this river indicate power possibilities of 11,000 horsepower at ordinary minimum flow and 16,000 horsepower with a regulated flow. On the God's River flowing from God's Lake the power potentialities are from 20,000 to 50,000 horsepower.

Flowing into the east side of Lake Winnipeg, the Pigeon, Berens, Poplar, Big Black and Manigotogan Rivers have power sites with capacities varying from 100 to 3,500 horsepower each.

The total estimated power capacity of each river and its location are shown in Table 34 and on the accompanying map of Manitoba showing water power resources.

The developed water powers of Manitoba, as previously stated, are principally those of the Winnipeg River. The hydro electric plants on the river supply the power requirements of Winnipeg and the adjoining munici-

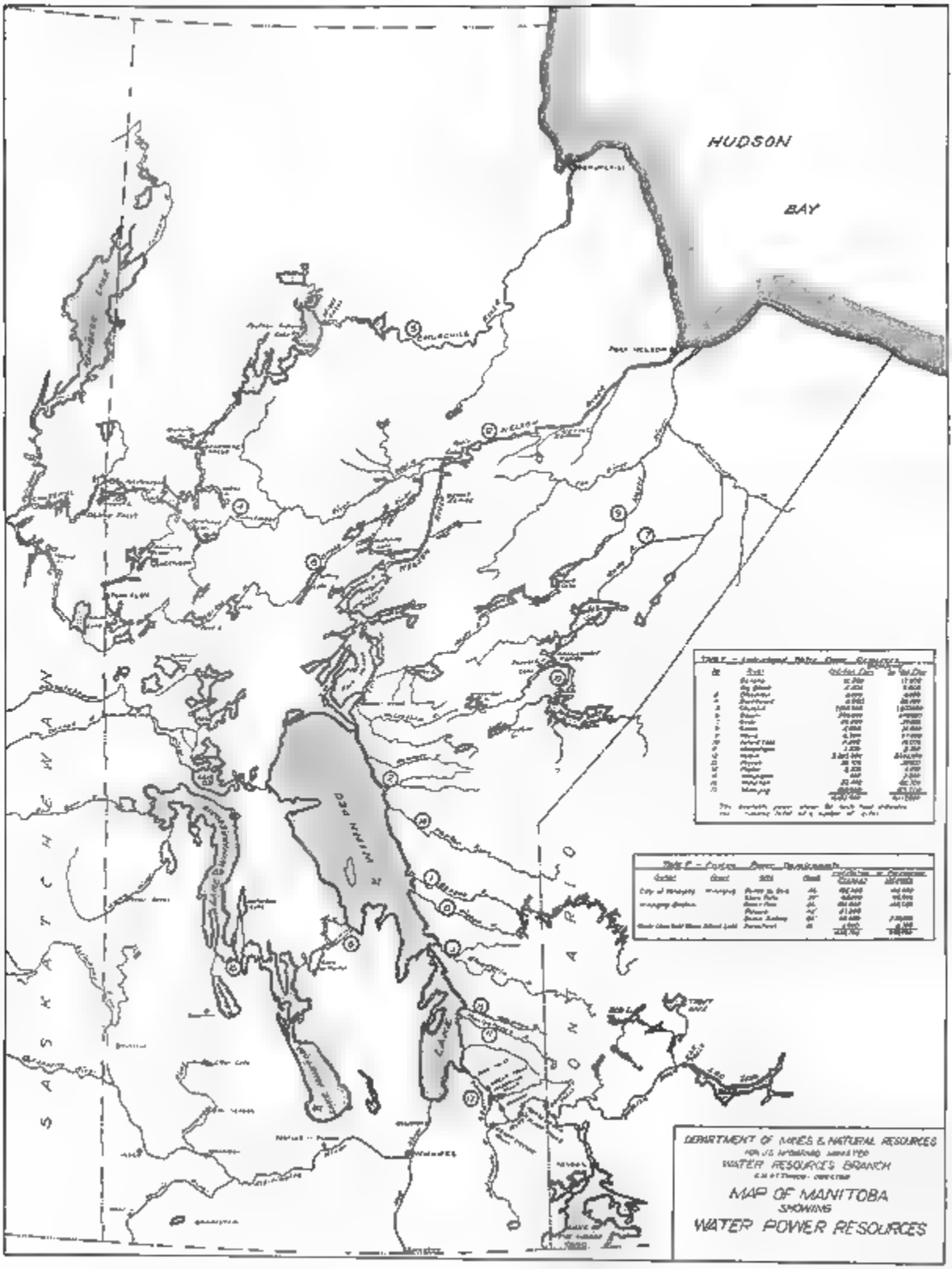

HUDSON
BAY
SASKATCHEWAN
DEPARTMENT OF MINES & NATURAL RESOURCES
WATER RESOURCES BRANCH
MAP OF MANITOBA
SHOWING
WATER POWER RESOURCES

TABLE 36 UNDEVELOPED WATER POWER IN MANITOBA

River	Capacity in Horsepower	
	Ordinary Minimum Flow*	Six Months' Flow**
Berens	12,500	17,900
Big Black	4,400	6,300
Bloodvein	4,000	6,600
Burntwood	6,800	98,400
Churchill	1,500,000	1,800,000
Dauphin	209,600	348,000
Gods	20,000	30,000
Grass	5,000	15,000
Hayes	5,700	17,000
Island Lake	11,000	18,000
Manigotogan	1,200	3,300
Nelson	2,235,000	3,032,000
Pigeon	23,700	38,000
Poplar	3,300	5,000
Wanipigow	400	2,200
Waterhen	36,400	46,300
Winnipeg	100,000	125,000
Total	4,185,000	6,197,000

*The ordinary minimum flow is the average of the minimum flow for the two lowest periods of seven consecutive days in each year, for seven years or any other period quoted.

**To calculate the six months flow the months in each year are arranged according to their average flows. The lowest of the six high months is taken as the basic month. The average flow of the lowest seven consecutive days in this month determines the six months' flow for that year. The average of such figures for all years in the period considered is the six months' flow for the period.

SEVEN SISTERS FALLS HYDRO ELECTRIC DEVELOPMENT ON THE WINNIPEG RIVER

palities, the rural towns and villages in southern Manitoba, the pulp and paper mills at Pine Falls, and the mining industry in the central Manitoba area.

Comment

It may appear entirely unnecessary to include in this report a list of water power resources, totalling millions of horsepower, when the electrification of 25,000 farms is not likely to require more than 30,000 horsepower. Particularly so, when it is realized that this amount of power is not more than 5% of the available power from the Winnipeg River. Nevertheless, there is in these great water powers, when utilized, the underlying possibility that they may contribute indirectly to the successful financing of a farm electrification system, in this respect their abundance and cheapness may ultimately have an important bearing on the subject.

CHAPTER XII

CONTROL OF THE WATER POWER RESOURCES OF MANITOBA

The Water Power Act

Until the year 1930 the water power resources of Manitoba were under the ownership and control of the Dominion Government. They were administered under the terms of the Dominion Water Power Act and the Water Power Regulations forming part thereof which provided "that the property in and the right to the use of all water powers are vested in and shall remain in the Crown. And further that all Dominion lands upon or within which there is water power, or lands required for the protection or the development of any water power, and the water powers and waters thereon shall not be disposed of except in pursuance of the Act and the Regulations." At the time of the transfer of the natural resources, the province enacted its own Water Power Act of March 12, 1930, adopting the Water Power Regulations of the Dominion except for a few minor changes which did not affect the licensees of the power sites.

The Province of Manitoba expressed its intention to carry on the policy of the Dominion respecting the ownership and the use of all provincial water powers, firstly in Section 2 of the Transfer of Natural Resources Agreement of December 14, 1929

> *Section 2.* The Province will carry out in accordance with the terms thereof, every contract to purchase or lease any Crown lands, mines or minerals, and every other arrangement whereby any person has become entitled to any interest therein as against the Crown, and further agrees not to affect or alter any term of any such contract to purchase, lease or other arrangement by legislation or otherwise, except either with the consent of all the parties thereto other than Canada or insofar as any legislation may apply generally to all similar agreements relating to lands, mines or minerals in the Province or to interests therein, irrespective of who may be the parties thereto.

and secondly in Clause 6 of the Water Power Act of March 12, 1930

> *Clause 6.* The property in and the right to use of all provincial water-powers are hereby declared to be vested in and shall remain in the Crown, saving, however, any rights or property in or to the use of such powers which before coming into force of this Act have been granted by the Crown in the right of the Dominion of Canada

The agreement with the Dominion requires the province not to change the terms of any license for a water power site granted by the Dominion except with the consent of the licensee or by general legislation applying to all water power licenses or agreements issued or made by the Dominion. Clause 6 of the Water Power Act confirms this agreement and declares that all water power sites shall remain vested in the Crown, excepting insofar as it is necessary to observe the contracts made by the Dominion.

Section 14 (2) of the 1930 Water Power Act grants to the lieutenant-governor-in-council the power "from time to time (to) make such regulations and orders not inconsistent with this Act as are necessary to carry out the provisions of this Act according to their obvious intent, or to meet any cases which arise, and for which no provision is made in this Act, and such regulations and orders shall be part of this Act, and without restricting the generality of the foregoing may make regulations."

Section 14 (4) of the Manitoba, 1930, Water Power Act confirms and continues the policy of the Dominion Government by the adoption of the Dominion Water Power Regulations

> Until the Lieutenant-Governor-in-Council makes regulations under the provisions of this Act, the water-power regulations established under the "Dominion Water-Power Act" by order-in-council dated October 31, 1921, published in the *Canada Gazette* of November 19, 1921, and as amended as to sections 48 (15) and 85A by order-in-council of September 10, 1923, published in the *Canada Gazette* of September 15, 1923, shall *mutatis mutandis* apply for administering provincial water-powers and such lands as may be required in the development, operation and use thereof "the Minister of Mines and Natural Resources," being substituted for "the Minister of the Interior," "the Department of Mines and Natural Resources" being substituted for "the Department of the Interior," "the Court of King's Bench" being substituted for "the Exchequer Court of Canada," "provincial lands" being substituted for "lands of the Dominion," "the Water Power Act" being substituted for "the Dominion Water Power Act" and "Provincial Water Powers" being substituted for "Dominion Water Powers," respectively

Water Power Regulations

Licensing—The Water Power Regulations set forth the conditions under which a license to develop a water power site may be obtained and the conditions under which the developed site may be operated. The regulations are complete in every respect and cover almost every conceivable point from the original application to the time when the government may repossess the works, lands, and properties of the licensee.

The standard term of the license is fifty years. "Every license shall be limited to such term not exceeding fifty years from the time fixed in the original interim license for the completion of the initial development, as may be agreed upon between the Minister and the licensee" (45,1)

The Province May Repossess

Repossession—The standard license permits the province to repossess the works, lands, and properties of the licensee at any time after thirty years from the time fixed for the completion of the initial development. In the event of repossession the province is required to pay the licensee a bonus for each year of the unexpired term of the license

> Section 45 (3) "At any time after thirty years from the time fixed for the completion of the initial development, upon twelve months notice to that effect having been given by the Minister to the licensee, His Majesty may repossess himself of the works, lands, and properties of the licensee, paying therefor compensation in accordance with the principles set out in Section 47 except that the Minister or the Court

of King's Bench, as the case may be, may in valuing the power development, add to the amount determined in accordance with subsection (3) of the said Section 47 a bonus equal to three-quarters of one per cent of such amount for each and every full year of the unexpired term of the license provided that in no case shall such bonus be less than five per cent of such amount and in valuing works and lands outside the severance line the Minister or the Court of King's Bench may increase the bonus as provided in subsections 5 and 6 of the said Section 47 to an amount not exceeding twenty per centum of the physical value of the works nor exceeding twenty per centum of the actual cost of the lands.

The standard license permits the province to possess, occupy, operate, and control the power development upon the expiration of the final license. The compensation to be paid to the licensee is provided for in Section 47 of the regulations:

Section 47 (1) Upon the expiry of the final license or upon the expiry of the time fixed in the said notice of termination, as the case may be, the power development shall become the property of the Crown, and the Minister, or such person as he may designate in that behalf, may immediately and without further proceeding enter upon, possess, occupy, operate and control the same.

(2) In the event that the Minister and the licensee are unable to agree upon the compensation to be paid for the said power development within one year after notice of termination has been given, either party may refer the matter to the Court of King's Bench.

(3) Compensation for the said power development shall be arrived at by first taking as a basis the figure previously fixed in accordance with Section 36 as the actual cost of the said development, then adjusting this figure so as to make allowance for any variation in the purchasing power of a dollar as shown by the official trade index or other official Dominion statistics most applicable to the case in hand, and finally deducting an amount equivalent to the actual loss in value of the said works due to their physical or functional depreciation or to other causes.

Rentals. The license requires each licensee to pay certain rentals. Ultimately these work out to be a charge in proportion to the amount of electrical energy generated, with a reduction in rate for plants operating with a high degree of constancy.

Section 48 (5) The rentals in the twenty-year period directly following the date fixed for the completion of the initial development shall be determined as follows:

a) The initial annual rental during such period shall be based upon the horsepower capacity of the installation required for the said initial development by the terms of the interim license. It shall be computed at a rate per installed horsepower which shall be fixed in the interim license for the special purpose of establishing the said initial rental and which shall in no case be less than fifty cents per installed horsepower.

b) The basis and the rate upon which the regular annual rental during such period shall be calculated shall also be set out in every interim license. Such basis shall be the horsepower-year of output and the rate shall be not less than shown on the following table:

Rental Per Horsepower-Year

When the annual load factor is less than 40 per cent the rate (minimum) shall be 90.0 cents per horsepower-year.

When the annual load factor lies between

40 per cent and 50 per cent shall be 87.5 cents per horsepower-year.
50 per cent and 60 per cent shall be 85.0 cents per horsepower-year.
60 per cent and 70 per cent shall be 82.5 cents per horsepower-year.
70 per cent and 80 per cent shall be 80.0 cents per horsepower-year.
80 per cent and 90 per cent shall be 77.5 cents per horsepower-year.
90 per cent and 100 per cent shall be 75.0 cents per horsepower-year.

Whenever during such period the amount determined by applying the schedule set out above to the output in horsepower-years exceeds the initial rental established according to the preceding paragraph (a) then the amount so determined shall constitute the annual rental

At the end of the first twenty year period directly following the date fixed for the completion of the initial development and every ten years thereafter, the annual rentals are subject to revision. It will be noted, however, that the province undertakes, as a condition of the licence, not to make an upward revision which would prevent the licensee earning an average fair return on the actual cost of the properties.

Section 34 (1) Upon the expiry of the said twenty year period and every ten years thereafter the annual rental shall be subject to revision

(2) Within six months before the termination of any ten year period, if either the Minister or licensee deems a revision of the rate of the annual rental per horsepower-year advisable he may notify the other party to that effect whereupon both parties shall endeavour to reach an agreement upon the said rate for the succeeding ten year period. Failing to reach such agreement within six months after the commencement of the said period, either party may refer the matter to such board, commission or authority as may be created or designated by the Lieutenant-Governor-in-Council for the purpose of revising the rentals. Such board, commission or authority in establishing the rentals to be charged shall take into consideration the earning capacity of the plant in question, the supply of power available from the plant and other sources in the surrounding district, the average selling price of the same and any special conditions or circumstances affecting the plant in question.

(3) The rentals for each year of such ten-year period shall be based on the actual station output for such year in horsepower-years as estimated at the turbine shaft by the Director. In the case of steam-operated plants the Director may use the switchboard records or any other available data.

(4) In the case of a licensee engaged in the sale of power an upward revision of the rate of the rental per horsepower-year may only be made provided such upward revision shall not make it impossible for such licensee to earn a fair net rate of return on the actual cost of the physical properties used and useful in connection with the undertaking, plus due provision for the amortization of such costs (including interest) as may be necessary and legitimate for promoting and organizing the enterprise and for providing capital otherwise than as included in the said actual cost. The costs which are to be amortized shall be fixed in the same manner and at the same time as the actual cost as set out in Section 36

(5) The fair net rate of return declared in the preceding subsection shall be considered as being cumulative from the date upon which the licensee first began the sale of power from the initial development.

Manitoba Power Commission Extension Account (Water Power Rents)

Section 8 of the Manitoba Power Commission Act requires all moneys received by the province as rentals for water powers, less the administration costs, to be paid into the Manitoba Power Commission Extension Account. From this account there is paid each year to the Manitoba Power Commission a sum equal to the interest and sinking fund on one half the capital cost of the commission's generating stations and transmission lines. The sums so paid, often referred to as the Water Power Rents, are virtually a subsidy contributed by the power users in the urban areas for the purpose of delivering power to the rural districts at lower cost

Section [illegible] All moneys received by the Province since the first day of May 1929 as rentals for water powers from the lessees thereof shall be paid into and form part of the Consolidated Fund and the proceeds of such payments, after deducting the cost of administering such water powers, shall be credited to the Manitoba Power Commission Extension Account.

2 From time to time on the recommendation of the Commission, approved by the Lieutenant-Governor in Council there shall and may be paid and applied from and out of the Consolidated Fund and charged to the Manitoba Power Commission Extension Account such sum or sums of money as may be necessary

(a) To pay an amount of interest equal to the interest charges and such sinking fund charges as may be determined by the Lieutenant-Governor in Council upon amounts not exceeding fifty per cent of the capital cost of constructive and erecting works required for the generation and transmission of power to municipalities, farmers or other persons to be supplied with power under the provisions of this Act

(b) To pay amounts to the Commission to be credited to municipalities, farmers or other persons who have heretofore entered into a contract with the Commission for the supply of power under this Act an amount equal to the interest charges and sinking fund charges or an amount not to exceed fifty per cent of the capital cost of the construction and erection of generating stations, transformer substations, protective devices, switching and metering equipment, transmission lines and cables or other equipment required for the generation and transmission of power to such municipalities or other persons, provided that where municipalities or other persons are indebted to the Commission under such a contract the said payment shall be applied on the outstanding indebtedness of such municipalities or other persons

3 If at any time there is an amount standing to the credit of the Manitoba Power Commission Extension Account in excess of the amount necessary to meet the expenditures made or to be made under this section or an amount on advance, the Lieutenant-Governor in Council may cause to be set aside or loaned under the Manitoba Loans Act such sum or sums of money as he may deem expedient for the purpose of making any such expenditures and interest on advances and may expend any moneys received for the purpose of making any of said expenditures or paying said interest on advances and the Lieutenant-Governor in Council may determine the rate of interest to be charged on such advances, and the amount of such advances and interest thereon shall be charged to the books of the province to the Manitoba Power Commission Extension Account

4 A statement showing the state of the Manitoba Power Commission Extension Account at the end of each fiscal year shall be embodied in the Public Accounts of the Province for that year (S.M. 1931, c. 37, s. 5 a.m.)

An examination of the Manitoba Power Commission Extension Account shows that between the fiscal years 1931 and 1940 $1,716,668.80 has been collected as water power rentals, $661,101.65 has been paid out as administration expenses, and a total of $1,353,920.15 has been paid to the Manitoba Power Commission in the form of a bonus for interest and sinking fund on one-half the capital costs of the commission's transmission lines and small standby generating stations. After making certain adjustments, there is now left a balance of $100,451.40 in the account.

Storage Charges

In a state of nature there is an irregularity of flow in most rivers which can be greatly improved by storing water in natural or artificial lakes, so that it may be used at periods when the run-off from the watershed is deficient. The Winnipeg River is an excellent example of water conservation by storage

for this purpose two main control dams have been built, one at the outlet of Lake of the Woods at Kenora and the other at the outlet of Lac Seul on the English River. Under an agreement with the provinces of Ontario and Manitoba the Dominion undertook to finance the building of the control dams. After assuming a portion of the cost as a proper charge against navigation, the remainder was assessed against the two provinces in approximate proportion to the benefits derived from the improvement in the potential capacity of the water power sites. In Manitoba the licensee of a water power site is required to assume his proper share of the cost of storage, and each year a payment is made to the province consisting of interest, amortization, and operating expenses.

Since the year 1930 the following total payments have been made to the Dominion by the Province of Manitoba for financing and operating the storage system of the Winnipeg River watershed:

Lake of the Woods capital charges	$417,762 66
Lake of the Woods operating expenses	68,348 04
Lac Seul capital charges	249,465 04
Lac Seul operating expenses	187,330 08*
	$922,905 82

*The interest assessed against the Ontario sites and now paid by the licensees of the developed sites in Manitoba is charged as an operating expense. This accounts for the Lac Seul operating expenses being several times greater than the Lake of the Woods operating expenses.

THRESHING BY ELECTRICITY ON A MANITOBA FARM

Summary and Conclusions

In this chapter it has been shown that the leased water powers of the province are held under the strict control of the Government of Manitoba. The standard term of license is fifty years. At its termination the province may take possession of the property of the licensee by making compensation in accordance with principles agreed upon and specified in the license. The province may also take possession of the property of the licensee at any time after the expiration of thirty years from the completion of the initial development by paying a small bonus for the unexpired term of the license.

Up to the present time the direct relation between the control of water powers and rural electrification in Manitoba has been through the appropriation of water rentals for the purpose of paying a bonus to the Manitoba Power Commission. These water rentals are virtually annual license fees paid to the province by the licensees, and may only be increased at specified times during the life of the license. No increase in rentals may be made which would make it impossible for the licensee to earn a fair return on his investment.

Under the terms of the Manitoba Power Commission Act farm lines are eligible for bonus and the Commission already receives a bonus for the lines supplying 561 farms that have been connected. There are not sufficient surplus funds available from water power rentals to provide the additional bonus required for a full programme of farm electrification and it is this fact, more than anything else, which makes the control of the water power resources of Manitoba a relevant and important part of this report.

CHAPTER XIII

ELECTRIC SERVICE IN AREAS NOT SUPPLIED WITH HYDRO POWER

An examination of the Manitoba Power Commission's network plan[1] for supplying hydro electric power to rural towns and villages will show that practically all the well-developed farming areas have, or will have, hydro circuits near enough to make this form of power available. However, at some time in the future it is possible that an enquiry may be made concerning power supply for areas not within reach of hydro lines. The following discussion is intended to outline the limitations and approximate operating costs if other forms of power are substituted for hydro power

General Considerations

Because there is an average of less than two farms per mile of line in Manitoba, the expenditure on farm distribution lines naturally becomes the largest item in the total cost of delivering power to the farm. Although, by careful organization, some economies may be made in the cost of distribution lines, the physical limitations of distance do not permit more than a small reduction in this initial financial handicap. It is therefore necessary to limit all other costs as much as possible, consequently the next most important item, the cost of power, must be kept as low as possible

As 65% of the energy supplied to the farm distribution lines is unavoidably lost in the conductors and transformers of the farm electrification system[2], every cent added to the cost of power increases the customer's bill 1½ cents. If cheap hydro power is not available, the alternative source of power, whether it be from a steam or diesel plant, must be engineered to approach the cost of hydro power as closely as possible

There is no substitute comparable to hydro power for farm electrification in remote districts, unless the service area is sufficiently large to permit the installation of a steam or diesel plant in excess of 1,000 horsepower capacity. The chief handicap of the small isolated power plant is the cost of operating labour per unit of output. It is not until the output of the thermal plant reaches 1,000,000 kwhr per annum that the labour cost can be kept within reasonable bounds. The operating labour required for a steam plant producing 1,000,000 kwhr per annum for delivery to a farm electrification network would be approximately as follows

	Annual Cost
3 regular firemen	$ 4,140 00
3 regular engineers	4,800 00
1 relief man	1,080 00
Half time superintendent	300 00
Total salary costs	$11,580 00
Pension fund payment	460 00
Total operating labour costs	$11,100 00
Operating labour cost per kwhr	1.1c

[1]See Chapter IX, page 186.

[2]If the farm lines were supplied with power from M.P.C. network there would be additional losses in the network

The following are the labour costs for a diesel plant.

	Annual Cost
3 regular operators	$4,860 00
1 relief man	1,620 00
Half time superintendent	900 00
Total salary costs	$7,380 00
Pension fund payment	295 00
Total operating labour costs	$7,675 00
Operating labour cost per kwhr	76c

An isolated farm electrification plant producing 1,000,000 kwhr per annum would lose 250,000 kwhr in the distribution system, delivering the remaining 750,000 kwhr to the customers. Assuming that the average consumption per customer is from 600 to 1,200 kwhr per annum, and making certain allowances for farms not connected to the system, the required area of the district supplied by the plant would be from 12 to 23 townships. It is doubtful if there is a well-developed farm area of this size in Manitoba which could not eventually be reached with hydro lines.

Steam Power

To produce power at a cost low enough for farm electrification requires a steam plant of sufficient capacity to carry a peak load of 400 kw. This plant would have to be located at a point where adequate water for condensing purposes could be found. The difficulty of finding a river or a lake of adequate capacity and close enough to the service area would, in nearly every case, exclude a steam plant from consideration. Even if adequate water supply were available, an isolated steam power plant of the capacity of 1,000,000 kwhr per annum would not be able to produce power in Manitoba at a cost much less than 8c per kwhr, to which would have to be added distribution costs.

Records of two steam power plants in Manitoba operating regularly throughout the year and supplying power to an urban distribution system show, in one case, a production cost of 2.7c per kwhr without administration expense and capital charges, the annual output of this plant is 1,250,000 kwhr. In the other case the records show a production cost of 3.38c per kwhr, with an annual output of 780,000 kwhr.

If it is assumed that with modern equipment the total cost of producing power from a steam plant of the capacity under consideration is 3c per kwhr, the effect of a 25% loss in the distribution system raises the cost of power to 4c per kwhr by the time it arrives at the customer's premises. Nor does this include the capital and operating expenses of the distribution system.

Diesel Power

Because diesel power plants can be operated without being located near a river or lake, and because the operating labour cost per unit of output has been shown to be lower than for a steam plant of equal capacity, it is only natural that we find the diesel plant selected for most isolated areas where hydro power is not available.

The best examples of diesel plant operation, under similar local conditions and of approximately the same capacity as would be required for farm electrification in Manitoba, are to be found in the system of the Saskatchewan Power Commission. Information based on the 1941 operating records, supplied to us by the Commissioner, Mr F A Thornton, is found in Table 33.

Table 33—Data on Three Saskatchewan Diesel Plants

	Location of Plant		
	Swift Current	Tisdale	Maple Creek
Installed capacity in kw	1,890	540	245
Capital investment per kw	$183 07	$157 89	$250 02
Peak load in kw (1941)	1,360	402	135
Kwhr generated (1941)	5,936,585	982,785	350,812
Fuel oil cost per kwhr	779c	849c	936c
Operating labour cost per kwhr	386c	612c	1 798c
Other operating costs per kwhr	427c	323c	484c
Total operating cost, not including capital charges	1 592c	1 784c	3 218c

In applying the foregoing costs to Manitoba, certain adjustments are required to provide for higher fuel oil prices Also, if the plants were operated in Manitoba by the Manitoba Power Commission, the capital charges would reflect the bonus paid by the province, namely, interest and sinking fund on one-half the capital advances. Furthermore, if the plants were built for postwar reconstruction, it would be reasonable to assume that money could be obtained at an interest rate of 3½%. Table 34 takes all these factors into consideration.

The conclusion to be drawn from the three Saskatchewan examples is that even with capital charges as low as 6.25% on one-half the capital cost, the small diesel plant, such as the one at Maple Creek, cannot be considered. It is not until the diesel plant attains an output of 1,000,000 kwhr per annum that the cost of power delivered to a farm electrification network can be reduced to something approaching 2 cents per kwhr.

TABLE 34—APPLICATION OF SASKATCHEWAN DIESEL PLANT COSTS TO ASSUMED POSTWAR CONDITIONS IN MANITOBA

	Location of Plant		
	Swift Current	Tisdale	Maple Creek
Total operating cost per kwhr, not including capital charges	) 592c	) 784c	2 218c
Additional cost of fuel oil	196c	212c	294c
Capital charges @ 2.5% on half of capital cost*	298c	270c	546c
Production cost per kwhr including all charges	2 086c	2 266c	3 058c

*In establishing the fixed charges on capital it is assumed that the interest rate on the debt will be 3.5%. The average life of the property is assumed to be 25 years, requiring a sinking fund of 2.75% (interest earnings at 3%. The total, 6.25%, is applied to one-half the capital debt in accordance with the present government policy applicable to the properties of the Manitoba Power Commission

Attention is drawn to the low capital charges of 6.25% on one-half the capital cost, resulting from the bonus and the low interest charges assumed. This is equivalent to 3.125% on the total. If normal capital charges of 5% interest and 2.75% sinking fund had been applied to the total capital cost, the cost of the power produced at a plant similar to the Tisdale plant would be increased to 2.67c per kwhr. Attention is also drawn to the fact that a generous bonus on the capital charges for a diesel plant is of less importance in terms of the price paid by the farmer for power than one might imagine. If there had been a capital bonus of 100% for the Tisdale plant, the total cost of producing power would have been reduced to only just under 2c per kwhr.

For comparison, the R.E.A. plant known as California 6 will be compared with the Saskatchewan Power Commission's Tisdale plant. (See Table 35.) These two plants started out with almost the same installed capacity, California 6 with a capacity of 512 kw, and Tisdale with 540 kw. It will be noted that the R.E.A. plant increased in capacity from 512 kw in 1939 to 792 kw in 1940 and 1941. These examples indicate that the main difference between the operating costs of the Tisdale plant and the R.E.A. California 6 plant lies firstly in the cost of fuel oil, a difference of 294c per

TABLE 35—COMPARISON OF OPERATING COSTS BETWEEN TYPICAL DIESEL PLANTS IN SASKATCHEWAN AND CALIFORNIA

	Tisdale (1941)	Calif. 6 (1939)	Calif. 6 (1940)	Calif. 6 (1941)
Installed capacity	540kw	512kw	792kw	792kw
Fuel oil cost per kwhr	849c	455c	512c	511c
Operating labour costs	612c	260c	477c	423c
Other operating costs	323c	090c	090c	083c
Total operating cost, per kwhr not including capital charges	1 784c	1 331c	1 078c	1 017c

kwhr, and secondly in the miscellaneous items, a difference of .227c per kwhr. An explanation of the latter is that the cost per kwhr for lubricating oil for the Tisdale plant is double that for the R.E.A. plant. It has also been noted that the maintenance cost per kwhr for the Tisdale plant is considerably higher than for the R.E.A. plant. Perhaps this may be due to the difference in age of the two plants under consideration. Attention is drawn to the reduction in the production cost of the R.E.A. plant after the capacity had been increased to 722 kw.

Other R.E.A. plant records have been examined for comparative purposes. It is found that when the basic Manitoba costs are applied, the following general statements may be made. The production cost per kwhr, not including capital charges, for a diesel plant in Manitoba of suitable capacity for a farm electrification network would probably be 50% greater than for comparable R.E.A. plants in the United States. Also, providing that capital funds can be obtained at 3½% rate of interest, and that a bonus is received equal to interest and sinking fund on one-half the capital debt, the total production cost, including capital charges, for a diesel plant in a postwar farm electrification scheme in Manitoba would be 2¼c per kwhr.

Wind and Gasoline-Driven Farm-Lighting Sets

The absence of electric power lines over large areas of farming land, and the evident demand for such service, have resulted in the development of self-contained electrical generating units suitable for farm use.

These units, wind and gasoline-driven, are obtainable in various sizes, from small units of 250 watts (746 watts equals 1 horsepower), suitable for little more than lighting, to larger units which can supply the farm with most of the electrical conveniences available to the town dweller except cooking and water heating. Service approaching that from a central station requires a capacity of around 1,000 watts or better. A unit of 1,000 watts can supply small motors up to ¾ hp., refrigerator, hot plate, electric iron, washing machine, and most of the usual small household appliances. In addition, brooders, water pumps, creamery equipment, and milkers can be operated in reasonable amount. It may be confidently asserted that the service will, within certain limits, equal that supplied by central station lines.

Each type of unit has its advantages and disadvantages. The wind-driven unit probably requires less attention than the gasoline-driven type. The former also has the advantage of no fuel cost. On the other hand, it is dependent upon the wind for its power so that there are likely to be periods during which it is inoperative owing to light winds, service being either completely cut off or available only to a limited extent, depending on the size and state of charge of the battery. This feature will be dealt with later on in this chapter.

Gasoline-driven units require fairly skilled attention to keep them in good running order, and fuel, the latter item representing a continuous running cost.

Both types of plants require a battery if twenty-four-hour service is desired. This feature represents a relatively high maintenance cost and requires care in operation if a reasonable period of service is to be obtained.

The cost of operating such plants is difficult to evalute even when the extent of service desired is known. There are so many variables between different uses that available costs from actual installations can be taken only as a guide.

In discussing the cost of electricity from such plants, the fixed interest and depreciation costs and the cost of labour to operate and keep such equipment in repair are frequently omitted. The money paid for such plants usually represents a substantial sum, which in many cases, particularly on farms of small income, might be employed to purchase other farm equipment, or if central station service were available, the funds might be used to purchase the small household electrical appliances, water system, etc., which are necessary if the maximum value of electric power is to be obtained, or even invested to bring in an annual income. Also, there is no denying that the life of such equipment is limited, and even if the interest and depreciation charges are eliminated from the calculation, there still remains the unpleasant fact that eventually the equipment will wear out and have to be replaced, representing a very definite cost of power production and quite properly chargeable to the same.

Cost of Power from Wind-Driven Plants

The following figures on the cost of operating wind-driven plants are reported by the Kansas State College of Agriculture and Applied Science in its Bulletin No. 39, published May 1, 1940. While they may not be strictly valid for Manitoba, they are nevertheless given as indicative of what may be expected:

Size. 1,000 watts, 32 volts
Battery 300 amp. hrs.
Assumed life of battery 6 yrs.

	Initial Outlay	*Annual Cost*
Cost of plant and 50-ft. tower	$220 00	
Cost of battery	180 00	
Total initial outlay	$400 00	
Generating plant		
Depreciation, 12½%		$27 50
Interest, 6% on half valuation		6 60
Repairs, 4%		8. 90
Taxes and insurance, 1%		2. 20

Battery	
Depreciation 16⅔% (6 yrs. of life)	$80 00
Interest, 6% on half the valuation	5 40
Taxes and insurance, 2%	3 60
Oil	50
Varnish	50
Labour (1 hr per month at 80c per hour)	9 60
Total annual cost	$88 70
Cost, assuming an output of 600 kwhr per year, per kwhr	14 8c

Similar costs with a 1,500-watt plant and an output of 1,200 kwhr per year gave a cost of 9.55c per kwhr For a 2,500-watt plant with an annual output of 1,500 kwhr the cost is given as 11 70c per kwhr

In Bulletin No 30 of the Kansas State College (1932) the annual cost, based on thirty wind-driven plants, is given as $138.30, although it is pointed out that the prices of these plants were from $150 to $200 in excess of what they could have been purchased for at the time of the report, a reduction for this excess would bring the annual cost to approximately $100.

An estimate given by the Manitoba Department of Agriculture Extension Service for a 900-watt, 32-volt plant is as follows

	Annual Cost
Generating plant (initial cost of head and propeller, $302.	
Depreciation, 10% per year	$30 20
Interest, 6% on half the initial cost	9 06
Repairs, 1%	3 02
Insurance, 1%	3.02
Cost of tower ($60)	
Depreciation, 5% per year	3.00
Interest, 6% on half the cost	1 80
Insurance, 1%	60
Initial Cost of battery ($255)	
Depreciation, (7-yr life)	36 43
Interest, 6% on half the cost	7 65
Insurance and taxes	2.55
Oil	1 00
Varnish	75
Total annual cost	$99 14
Cost per kwhr, assuming an output of 500 kwhr per year	19 8c

As different figures for cost of plant and for fixed charges are given in the above examples, it was thought advisable to make an estimate based on what the Commission believes would more nearly represent what could be done with a 1,000-watt 32-volt plant, taking such figures for interest and depreciation as could be reasonably assumed possible after the war and omitting taxes and labour costs. The results of this analysis follow

Size 1,000 watts, 32 volts
Battery 350 amp hrs. (240 on 8-hr. rate)

Cost of unit (1939)	$218 50
Cost of tower	121 00
Cost of battery	235 00
Labour for erecting	55 00
	$629 50

Assumed life of generator and tower: 20 years.
Assumed life of battery 7 yrs.
Interest at 3½%.
Depreciation on 3% sinking fund basis.

	Annual Cost
Generating plant and tower:	
Depreciation, 3.7% on $374.90	$13 84
Interest, 3½%.	13 09
Repairs, assumed, 1%	3 75
Insurance, 75c per $100	2 80
Battery	
Depreciation, 13.05% on $255	33 28
Interest, 3½%.	8 93
Insurance, 50c per $100	1 27
Total annual cost	$76 96

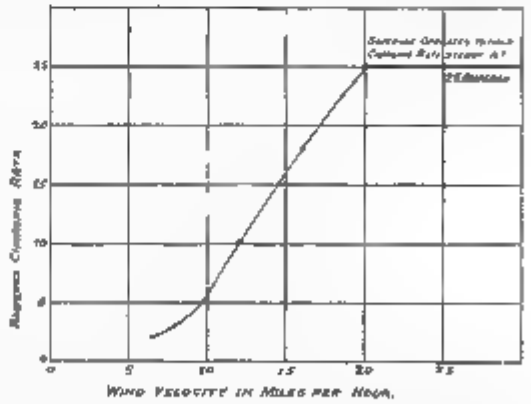
Assuming an output of 1,000 kwhr per year, cost 7.7c per kwhr
Assuming an output of 500 kwhr per year, cost 15.4c per kwhr.

Table 36 is a summary of the costs of a wind-driven plant as presented in these various tabulations. From an inspection of these costs it is evident that the cost per kwhr decreases as the annual output increases, but the tendency of the cost per kwhr is to be high

TABLE 36—SUMMARY OF COSTS OF WIND-DRIVEN PLANTS

Source	Size of Unit	Annual Output	Cost per Kwhr
Kansas State College	1,000 watts	600 kwhr	14 8c
Kansas State College	1,500 watts	1,200 kwhr	9 55c
Kansas State College	2,500 watts	1,500 kwhr	11 70c
30 plants	Various (assumed)	1,000 kwhr	13 50c
Manitoba Dept of Agric Extension Service	900 watts	500 kwhr	19 8c
Commission estimate	1,000 watts	1,000 kwhr	7 7c
Commission estimate	1,000 watts	500 kwhr	15 4c
Iowa State College		840 kwhr	10 0c

Just what output can be obtained from a wind-driven generator depends upon the wind velocity It is generally accepted that a wind of at least eight miles per hour is required to start the generator charging the battery. Figure 1 presents the curve for a modern wind-driven plant, showing how the output varies with wind velocity.



MANUFACTURER'S CURVE SHOWING RELATION OF WIND VELOCITY AND CHARGING RATE FOR A 1000 WATT, 32 VOLT WIND ELECTRIC POWER PLANT

FIG. 1—CURVE SHOWING RELATION BETWEEN OUTPUT AND WIND VELOCITY FOR A MODERN WIND-DRIVEN UNIT

Records of the wind velocity at Winnipeg and Rivers, Manitoba, for the year 1941 were obtained from the Western Superintendent of the Department of Transport, from these data Tables 37 and 38 were compiled.

TABLE 37—NUMBER OF DAYS IN 1941 ON WHICH WIND WAS 8 MILES PER HOUR OR OVER

No. of Hrs. During Which Wind Was 8 Mi. per Hr or Over	No. of Days of Velocity 8 Mi. or Over	
	Winnipeg	Rivers
19-24	230	145
13-18	78	111
7-12	44	71
0- 6	10	38

TABLE 38—WIND VELOCITIES FOR YEAR 1941 AT WINNIPEG AND RIVERS

Miles per Hr.	Total No. of Hrs. of Wind of Velocity Indicated											
	Jan.	Feb.	Mar	Apr	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
WIND VELOCITY AT WINNIPEG												
0- 7	146	116	154	162	113	165	247	251	97	120	150	194
8-10	156	108	111	154	119	137	194	180	136	158	129	128
11 and over	442	443	479	404	512	418	303	313	487	456	441	422
WIND VELOCITY AT RIVERS												
0- 7	810	271	259	201	129	205	363	167	236	276	229	273
8-10	129	155	149	150	151	140	151	279	125	135	150	154
11 and over	311	246	336	369	464	377	230	298	368	271	361	315

A report of the Department of Agricultural Engineering of the University of Saskatchewan, compiled by J. R. Young, states that a 250-watt plant operating for 230 days produced 101 46 kwhr, which would equal 161 kwhr per year. The report further states "The daily average output of 0.441 kwhr is exceptionally good for this size of plant."

Tests by the same authority on a 1,000-watt, 32-volt wind-driven plant from December, 1939, to November, 1940, inclusive, produced during the year an equivalent of 3.02 kwhr per day. For 13 days in January, owing to calms, the batteries were too low to produce usable current, and there were 39 days throughout the year when the batteries did not have sufficient energy to supply useful consumption. The statement is also made that an average of 1,320 kwhr per year might be expected from a 1,000-watt plant under normal conditions of wind at Saskatoon.

A study of the operation of a 1,000-watt, 32-volt wind-driven plant made in 1936 by the Oklahoma Agricultural and Mechanical College, results of which are given in Publication No. 29 (Wind-Electric Power for Small Farms), investigated the relation between the kwhr generated per month and the monthly wind movements in miles. Using this data, and a table of miles of wind movement per month at Winnipeg for the year 1941, supplied by the Winnipeg Office of the Meteorological Division of the Department of Transport, a possible generation of 2,073 kwhr for the year is indicated, or an average per month of 173 kwhr, the maximum generation in any month being 242 kwhr and the minimum generation per month 102 kwhr.

The thirteen-year average of the miles of wind movement per month for the years 1921 to 1933 at Winnipeg, supplied by the same office, indicates a possible annual generation of 1,098 kwhr, a maximum monthly generation of 123 kwhr and a minimum monthly generation of 58 kwhr for the period.

In a thesis prepared in 1941 by H. H. Beatty of Iowa State College, entitled *Wind-Electric Plants*, a study is made of 100 wind-electric plants operating in the Middle West. It is indicated that 47% of those showed no shortage of power because of insufficient wind, while 25% did report such a power shortage. Sixty-two per cent of the operators indicated that precautions were taken to conserve power for low wind periods, and twenty farmers bought second-hand engine-driven plants to supplement their wind plants.

It would seem reasonable that a 1,000-watt wind-driven generator should be able to produce 1,000 kwhr per year under average wind conditions in Manitoba. There would undoubtedly be periods when, owing to light winds, the generator could not deliver useful current, but assuming a battery of 360 ampere hour intermittent rating, by reducing the load, the plant should be able to carry over and supply lighting and a few other essential services. Starting with a fully charged battery of this size, there would be stored 11.5 kwhr or sufficient, with reasonable care, to carry on for three or four days.

Gasoline-Driven Units

Gasoline-driven units have the advantage over wind-driven plants in that they are not dependent upon the wind for their output, but against this must be set the cost of fuel, necessary at all times that the plant is operating. There is also the danger of fire from the use of gasoline in buildings, and if the plant is to be maintained in good operating condition, more skilled attention and maintenance are required than for wind-driven plants.

Since the fuel consumption of a gasoline engine per unit of output varies greatly with the load, consumption at light load being four to five times that at full load, it is evident that the cost per unit of output depends upon the load at which the engine is run.

Bulletin No. 30 of the Kansas State College Engineering Experimental Station gives results of laboratory tests on two 1,500-watt and one 800-watt generating sets, indicating a fuel consumption at full load of 0.278, 0.297, 0.348 U.S. gallons per kwhr. At 25.5c per Imperial gallon (price of gasoline to farmers in 1939) these figures represent a fuel cost per kwhr of 5.9c, 6.3c, and 7.4c respectively. On the same engines the consumptions at approximately half-load were 0.391, 0.421, 0.495 U.S. gallons per kwhr at 25.5c per Imperial gallon, a cost per kwhr of 8.3c, 8.9c, and 10.5c respectively. At smaller loads the consumption per unit of output is shown to increase even more rapidly.

Bulletin No. 39 of the same college reports tests on a 1,500-watt set for which the fuel consumption at full load was 0.243 U.S. gallons per kwhr, a

cost per kwhr for fuel (at 25.5c per Imperial gallon) of 5 16c. Three other tests estimate fuel costs as equivalent to 6.3c per kwhr on 25.5c gasoline.

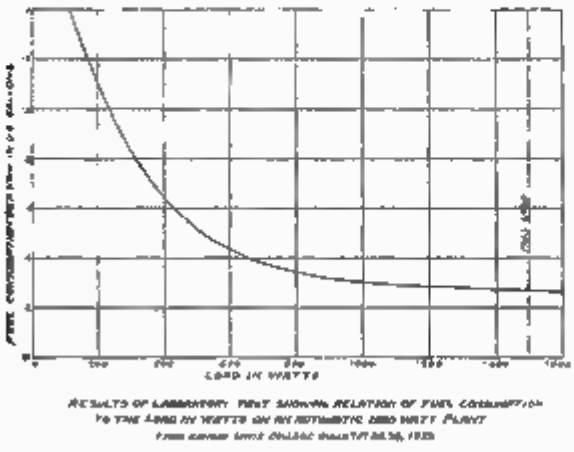


Fig 2—Fuel Consumption per Kwhr of a 1,500-Watt, 32-Volt Gasoline Electric Plant (Kansas State College Bulletin No. 30, 1932)

Test data given by a large manufacturer on a 2-horsepower modern-type gasoline engine, using non-leaded gas, give the consumption per horsepower-hour as 0.11 and 0.16 U.S. gallons at full and half-loads respectively With the usual efficiency this would represent a consumption per kwhr of 0.164 and 0.24 Imperial gallons, or a cost per kwhr, with fuel at 25.5c per Imperial gallon, of 4.18c and 6.12c. One of these tests is shown graphically in the accompanying figure

Table 39 reports figures from University of Kansas Bulletin No. 30, 1932, which are of particular interest, being the results of a year's operation, checked by meters, of three typical gasoline-driven plants installed on farms and indicating actual fuel costs at 12c per U.S. gallon. From these figures it can be

Table 39—Annual Costs of Three Gasoline-Driven Plants

Cost	Plants A	B	C
Plant Depreciation at 10%	$ 33 60	$32 50	$33 80
Battery Depreciation at 16⅔% (6 yrs. life)	35. 83	25 00	35 83
Interest on plant and battery at 6% of half the valuation	16 62	14 25	16 62
Taxes at 2% on one-half the valuation	5 54	4 75	5 54
Insurance at 95c per $100 of half the valuation	2 63	2 26	2. 63
Operating Expenses			
Fuel	35 30	9 42	23 62
Oil	2. 54	2 70	6 24
Repairs	1 00	75	7 00*
Labour, 26 hrs. at 30c per hr.	7 80	7 80	7 80
Total cost per year	$144. 16	$ 99 43	$144. 18
Total kwhr used	694 8	106 10	636
Cost per kwhr	20 74c	93 5c	22 6c

*Plant overhauled during the year

estimated that the gasoline cost per kwhr was 5.5c, 8.9c, and 4.5c respectively for the three plants. As these costs were based on gasoline at 12c per U.S.

gallon, at the Canadian price (25.5c per Imperial gallon) the fuel cost per kwhr would be 9 7c, 15 7c, and 7 9c respectively It should be noted that the output of Plant B is relatively small, the results indicating that few appliances were supplied from this plant. Plant A was operating incubator and brooders, and Plant C, which had the largest consumption, was supplying electric milkers.

Also estimates for three other plants of 500 watts, 800 watts, and 1,000 watts, based on gasoline costs of 10c per U S. gallon, give a fuel cost per kwhr for the year as 6 2c when adjusted to 25.5c for an Imperial gallon. Other figures give the cost of 102 individual gas engine electric plants as $128.71 per year

Similar tests taken on actual farm installations by the Agricultural Experimental Station of the University of Nebraska, and published in their Bulletin No. 235, gave fuel consumption for an 850-watt plant having an annual production of 779 kwhr as 0.838 U.S. gallons, or 0 7 Imperial gallons per kwhr, which at 25.5c per gallon gives a fuel cost per kwhr of 17.85c.

An 800-watt automatic plant, having an annual production of 361.5 kwhr in eleven months, had an average fuel consumption of .66 U.S. gallons, or .55 Imperial gallons, or a fuel cost at 25.5 per gallon of 14c per kwhr For the following year, with a production of 428 kwhr, fuel costs on the same basis were 13.35c per kwhr. A 1,500-watt automatic plant, producing 634 kwhr during the year, had an average fuel consumption of 73 U.S. or .61 Imperial gallons, which at 25.5c per gallon is 15.5c per kwhr An 850-watt semi-automatic plant, having a production of 469 kwhr in eight months, had a fuel cost per kwhr, on the same basis as above, of 12.75c per kwhr

As in the examples given for wind-driven sets, different values are set for the cost of plants and fixed charges in the above estimates. Accordingly, an estimate similar to that made by the Commission for wind-driven units was made on the following basis.

Size 1,500 watts, 32 volts
Battery 360 amp. hrs
Annual life of generator and engine: 15 yrs
Annual life of battery 7 yrs.
Cost of unit $431
Cost of battery $265
Annual output 1,000 kwhr

	Annual Cost
Generating Plant	
Depreciation, 5.36% on $431	$ 23 19
Interest, 3½%	15 75
Repairs, assumed, 2%	8 62
Insurance, 50c per $100	2 15
Fuel, based on 7c per kwhr	70 00
Oil	5 00
Battery	
Depreciation, 13.05% on $265	34 58
Interest, 3½%	9 28
Insurance, 50c per $100	1 32
Total annual cost	$169 89
Cost per kwhr	17c

TABLE 40—SUMMARY OF COSTS OF GASOLINE PLANTS

Source of Report	Size of Unit	Annual Output	Cost per Kwhr	Fuel Cost per Kwhr based on 25.5c per Imp. Gal	Remarks
		ACTUAL RESULTS OF FARM USE			
Kansas State College	750 watts	694 8 kwhr	20 8c*†	9 7c	Record kept of cost and output for one year's operation
Kansas State College	750 watts	108 1 kwhr	93 5c*†	15 7c	
Kansas State College	750 watts	658 kwhr	22 8c*†	7 9c	
University of Nebraska	350 watts	779 kwhr		17 35c	12 months' record.
University of Nebraska	900 watts	361 5 kwhr		14 0c	11 months' record
University of Nebraska	1,500 watts	684 kwhr		15 5c	12 months' record
University of Nebraska	850 watts	469 kwhr		12 75c	8 months' record
Kansas State College (results of 108 plants)	Various	500 kwhr	25 7c		Output assumed.
		ESTIMATES			
Kansas State College	500 watts	360 kwhr	23 76c**	6 9c	Gasoline assumed at 10c per U.S. gal
Kansas State College	800 watts	600 kwhr	19 68c**	6 9c	
Kansas State College	1,000 watts	1,200 kwhr	16 34c**	6 9c	
Commission estimate	1,500 watts	500 kwhr	26c††	7 0c	Gasoline assumed at 25.5c per Imp. gal.
Commission estimate	1,500 watts	1,000 kwhr	17c††	7 0c	
Commission estimate	850 watts	600 kwhr	16 5c††	7 0c	

*Gasoline cost, 12c per U.S. gal.
†See note in detailed report
**Gasoline cost, 10c per U.S. gal.
††Gasoline cost, 25.5c per Imp. gal

With an annual output of 500 kwhr, the fuel consumption assumed to be one-half the above amount, the annual cost would be $130.54, or a cost per kwhr of 26c. Similar estimates on an 850-watt plant with an annual consumption of 600 kwhr would give a cost of 16.55c per kwhr

Below will be found results of laboratory tests on the fuel consumption of gasoline-driven units when operated at full load. Gasoline costs are estimated at 25.5c per Imperial gallon

Tester	*Size of Unit*	*Fuel Costs*
Kansas State College	1,500 watts	5 9c per kwhr
Kansas State College	1,500 watts	6 3c per kwhr
Kansas State College	800 watts	7 4c per kwhr
Kansas State College	1,500 watts	5 10c per kwhr
Manufacturer	2 horsepower	4 18c per kwhr

From the variation in the figures (quoted in this section), both for total cost per kwhr and for fuel cost per kwhr, the dependence of cost upon output becomes evident, although, owing to the fuel cost, there is not the same relationship as with wind-driven sets.

In both gas and wind-driven units no allowance is made for wiring of buildings or for electrical appliances, costs which would be incurred whether an individual generating plant was purchased or energy secured from a central power station

Sufficient detailed information is given in the above estimates to enable an adjustment of costs to suit any particular condition which it may be desired to estimate. A summary of the costs of various gasoline plants is given in Table 40

It is possible that a saving in fuel cost could be effected by using distillate or kerosene in place of gasoline. Starting and running conditions of the engine would be less efficient, but the user might consider such defects compensated for by the decreased fuel cost. It may be taken that about the same quantity of fuel would be required in either case, so that fuel cost adjustments can easily be made in the above estimates.

Looking to the future, it is possible that after the war improved generating units and batteries at decreased costs may greatly reduce the generating costs of these farm units, but this, of course, is merely conjecture.

Conclusions

Where central station service is not available, limited electric service can be obtained by either wind or gasoline-driven units. Both types require attention and care if reasonable life and satisfactory service are to be obtained. The cost per kwhr, when everything is taken into account, is rather high; and the size of motors and apparatus is limited by the size of the unit. Unduly large motors and equipment mean larger generating units with correspond-

ingly high capital and high cost per kwhr, particularly if the annual consumption is small. Wind-driven sets are dependent upon wind conditions and may be out of service during prolonged calm spells.

Gasoline-driven units, while not suffering from this disadvantage, are costly as regards fuel per kwhr of output, especially on light loads, and entail constant operating expense. The actual cost per kwhr depends upon the annual output, as well as on whether the machine is utilised on light or full load. With a large plant, such as is required to operate many appliances, the annual consumption must be fairly high to bring the cost per kwhr within reason. If a smaller plant is installed to decrease the fixed charges and thereby the cost per kwhr, then the service obtained is limited.

On the other hand, central station service has a fixed maximum rate and usually a quickly decreasing rate for increased consumption, resulting in much less uncertainty as to what the cost will be. Also, within reason, there is no such limit to the apparatus which may be connected to the service as is found in small individual generating units. Maintenance and operating labour are eliminated and service is usually continuously available merely by turning the switch. Appliances are usually cheaper, more reliable, and of greater variety for the standard 110-volt service, owing to the large demand for such as compared to that for 32-volt appliances, although it should be stated that 110-volt plants are available.

However, if 110 volts are desired in order to take advantage of the increased convenience given by the larger selection, lower prices, etc., of the standard 110-volt apparatus, then the cost of batteries makes the small farm lighting set more costly than is indicated by the figures of the foregoing tabulations. Considering the rates for electric service which may be expected from a central power station in Manitoba, the Commission concludes that neither wind-driven nor gasoline electric plants can offer serious competition to central station service. The only exception might be the wind-driven plant, where the consumer is satisfied with limited lighting service and the operation of small appliances. However, when the consumer cannot secure central station service because of distance from the line, both wind and gasoline plants have a role to play in farm electrification.

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The Commission, in the course of its work, gathered a large quantity of pamphlet and other material, which has been turned over to the Provincial Library, where it has been assembled into a special department by Mr. J. L. Johnston, librarian.

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